ISSN 1173-5996

Study of Evacuation Movement through Different Building Components

P Holmberg

Supervised by

Hakan Frantzich
Lund University, Sweden

Fire Engineering Research Report 97/4
May 1997

This report was presented as a project report as part of the M.E.(Fire) degree at the University of Canterbury based on research carried out at Lund University Sweden

This report was also published as Report 5005 of the Department of Fire Safety Engineering, Lund University, Sweden

School of Engineering
University of Canterbury
Private Bag 4800
Christchurch, New Zealand

Phone 643 366-7001
Fax 643 364-2758

ABSTRACT

These experiments were conducted in order to obtain data on the walking velocities, twisting rates and flow rates in different building components. The building components studied were doorways and corners. An experiment was also conducted to find the effect of opposed flow on these parameters. Students were used as the test subject in these experiments. After the experiments had be conducted the data was extracted using an image analysing technique. This involved using the video footage of the experiments. This video footage was firstly converted to a computer file using a video film capturing package. The resulting computer file was then able to be analysed using the computer program Persias which is able to calculate velocities, distances, and twisting rates of people or objects.

The experiments provided velocity data as a function of the interperson distance and the results obtained are similar to the results obtained in previous research which gives the movement velocity as a function of the occupant densities.

ACKNOWLEDGEMENTS

Håkan Frantzich - Supervised me in this project giving me both ideas and help whenever needed.

Charley Fleischmann - For all his help through the first half of the fire engineering course.

Andy Buchannan - gave me the oppurtunity to travel to Sweden to complete my Masters education in another country which was a great experience and a lot of fun.

Robert Jönsson - Along with Andy Buchannan organised the exchange between New Zealand and Sweden and also helped supervise the project.

My Fire Engineering Class : James, Kev, Greg, Derek, Thomas, Ant and Mike. - All good friends who helped each other through the first half of the fire engineering course.

The Fire Enginneering Students at Lund Universtiy - All helped as test subjects for the experiments that I conducted and also for being good friends and making me feel at home in another country.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

This report investigates evacuation movement in a variety of situations. The purpose of this report is to derive design values for movement velocities through the various building components analysed. The different situations that have been studied are movement through a doorway, movement around a corner also investigated was opposed flow where there is one or more people moving against the main flow of people evacuating. This study finds the movement velocities as a function of the interperson distance. The interperson distance is the distance between the centre of two individuals bodies when viewed form above. This is different from previous research which finds this movement velocity as a function of the population density in the area that is being analysed. By using interperson distance as opposed to density the occupants are treated more as individuals and their velocities are able to be changed more easily as their circumstances change with time. By choosing a density controlled velocity all the are assigned a velocity relative to the chosen density though the circumstance may change with time.

Now that there is new computer software available that uses the interperson distance when determining the movement velocities of individuals new data needs to be obtained to check the velocities that are used. Data from previous research can be converted from using density to interperson distance if it is assumed that the occupants are equally spaced though in a real life situation this is not the case.

These experiments were all conducted in a laboratory using students as test subjects. The students were asked to walk through the various building components and the experiments were filmed. This film was then analysed using an image analysing technique that was developed for this purpose and the resulting data was stored in spreadsheet format. The parameters that were obtained in this analysis was the movement velocity, interperson distance and the twisting rate at each time step.

The results obtained from these experiments all indicate a constant velocity that is independent of the interperson distance until a threshold distance is reached. Once this threshold distance is reached the velocity will the decrease rapidly towards zero as the interperson distance is decreased. The constant velocity was found to be around 1.2m/s in all

these experiments until this threshold distance was reached. The threshold distance in all the experiment were in the range from 0.8 - 1.0 m after which the velocity would start to decrease. Another parameter that was found in these experiments was the 'body twist' or rate of turning of the individuals. This value is another important parameter that is used in the new computer models as it shows how fast the individual turn to seek a new direction. The maximum twisting rate was found in each of these experiments.

1 INTRODUCTION

There can be many reasons to evacuate a building. The most obvious of these is fire and/or smoke but there can also be many other reasons. Some of the other reasons could be an earthquake, a toxic gas leak in the building or nearby, a bomb threat or a civil defence emergency. Therefore the evacuation of a building needs to be carefully and accurately designed, to make the evacuation as quick as possible.

1.1 Design Methods Available

A new building act, The Building Act 1991 was introduced into New Zealand in December 1991 and this requires all new building construction to be in accordance with the building code. The primary concern of the Building Act is with the safety of the buildings occupants and includes such factors as structural stability, access, safety of the users, services and facilities. Secondary concerns include factors such as access for fire fighters and prevention of fire spread to adjacent properties. The Building Act is not concerned with fire damage or fire spread within the fire building as long as the safety of the building occupants is assured.
The fire requirements of the Building Act are divided into four different categories. They are:

- C1, Outbreak of fire
- C2, Means of Escape
- C3, Spread of Fire
- C4, Structural Stability during Fire

For each of the categories listed above the performance requirement of the building code must be met. The objective, functional requirement and performance for each of the four fire categories are included in Appendix A.
There are two main methods used to design an escape route for a building in New Zealand. Both are acceptable as long as the performance requirements are met. The methods are:

- Building Industry Authority (BIA) Acceptable Solutions (a prescriptive solution)
- Specific fire engineering design

The first of these, using the acceptable solutions involves the designer having to comply with the acceptable solutions C1, C2, C3, and C4. These documents are prescriptive in nature and will give the designer the minimum sizes of the escape route such as height and width depending on both the occupant load and the purpose group of the building (the classification of spaces within a building according to the activity for which the spaces are used). The maximum lengths of the escape routes open paths or protected paths will also be given and this depends on both the purpose group and whether there are any fire safety systems present. This method is a lot simpler than the specific fire engineering design but does not allow as much flexibility. Also the Acceptable Solutions are not relevant to buildings that have a very high fire load (greater than 1500 MJ/m^2 of floor area). When a building has a fire load above this, the second method of specific fire engineering design must be used.

As New Zealand now has a performance based building code it is possible to find alternatives for the design of the building as long as the solution meets the objectives as set out by the building code. This method is becoming more common especially in the more complex building designs where the first method is uneconomical or unable to be used. This method involves comparing the calculated egress time with the time calculated for the building to reach untenable conditions, taking into account an appropriate factor of safety.

Both of these methods have advantages and disadvantages. By using the acceptable solutions the design of the building becomes simpler and therefore the cost of the design is less as the time taken for the design is reduced. However the acceptable solutions can be over conservative and this can lead to a much more expensive building.

By using a specific fire engineered design the design cost will usually be more expensive but the total cost of the building may be cheaper as the building construction costs can be considerably cheaper.

When designing a building using the specific fire engineered design method, information on the evacuation behaviour of the occupants becomes an important factor as the evacuation time is required and needs to be predicted accurately.

1.2 The Evacuation Process

The evacuation time of a building is the time taken from the ignition of the fire until all the occupants have reached a place of safety. This time includes:

- detection time
- response time
- travel time

The total time for the evacuation can then be evaluated and compared to time calculated for the building to reach the tenability limits taking into account an appropriate factor of safety.

1.2.1 Detection Time

This is the time taken from the ignition of a fire until the occupants in the building become aware of the problem. The detection could be in the form of an automatic detection system and alarm or a person becoming aware of the fire due to the smoke or flames. The awareness time in a fire incident can vary greatly and can be quite long especially when there is no automatic detection system present.

1.2.2 Behaviour and Response Time

The behaviour and response time is the time taken from when the occupants first become aware of the situation until the evacuation or movement phase begins. This phase first starts when the occupant becomes aware that there is a problem and decides what course of action to take. This action may not necessarily be to evacuate the building but could be to investigate the problem, fight the fire, warn and help others, call the fire department, collect belongings, or the occupant could even decide to ignore the situation.

This phase can take a considerable amount of time so therefore needs to be able to be predicted in order to be able to get a reasonable prediction of the total evacuation time.

1.2.3 Travel Time

The travel time is the time taken from when the occupants start to evacuate until all the occupants have successfully evacuated the building. The travel time is the main focus of this report. The travel time is calculated by summing the different movement times through different building components as the occupants make their way to a final exit. To make these calculations possible we require the different walking speeds through various building components such as doorways, corridors and stairs. This report will attempt to find the various walking velocities through doorways and around corners while also getting data on the turning rates of people as they either overtake or turn to take a new path. The other aspect that will be covered in this report is that of opposed flow as may be present if a fire-fighter attempts to enter a building against the main flow of the occupants as they are evacuating.

1.3 Limitations

The material presented in this report is based on the study of movement velocities involved in evacuation. Users of this material should be aware of the limitations of the data.
Firstly the experiments were conducted in a laboratory situation where the test subjects were aware of what was going on and were also familiar with the experimental set-up. Also the subjects used in the study were all fit, young and healthy adults and there was no one involved in the tests that had any form of disability. The velocities obtained can also vary quite considerably from individual to individual as can be seen by the large scatter in the data obtained. The data obtained also does not represent an actual fire situation where the occupants might try to exit the building with a bit more urgency. In many cases the results from these experiments could be used as design values but the designer has to be aware of the limitations and of the occupants that will be present in the building to be designed.

2 DEFINITION OF THE PROBLEM

The movement of people through doorways and the movement of people around a corner are both important aspects of the evacuation of a building. These building components form an integral part of the escape route, therefore the behaviour and movement characteristics of people in these situations needs to be predicted as accurately as possible. There has been many studies finding the movement velocities of people through these building components. Most of these studies have involved finding the velocity as a function of the occupant density. In these experiments the velocity is found as a function of the interperson distance or distance between individuals. Though the previous data can be converted from density to interperson distance using a simple relationship, doing this is not strictly correct as the spacing of the individuals has to be assumed to be uniform which is not the case in a real life situation. By using interperson distance instead of density in a computer model the occupants will be treated more as individuals than as a crowd.

The experiments of movement around corners and through doorways were performed because, as well as stairs they are the main building components the occupants will face when evacuating a building. The study of movement on stairs has already been conducted using the method presented in this report [Frantzich, 1996]. There is however little data previously presented on the movement around corners and through doorways so more studies were required to get an accurate prediction of the evacuation times and to check the values that are currently being used by Simulex. The velocities used at the moment for these situations are the velocities for general horizontal movement.

As well as corners and doorways another situation that has been studied is that of opposed flows. This studies the effect on the movement pattern if there is one or more people moving against the main flow of people. This could be the case if there are fire fighters entering the building using the same route that the occupants are using to escape. Very little study has been done on the effect that opposed flow has on the movement velocity and overall flow rates though some research has suggested that there is little effect and the flow rates obtained are only slightly less than that of unidirectional flow.

The analysis of these experiments involved finding the movement velocities of individuals as a function of the interperson distance and their turning rates. Interperson distance is defined as the distance between the centre of the body of the assessing person to the centre of the body of the obstructing person. The second parameter that is to be found is the maximum turning rate or the 'body twist' of the individuals involved in the evacuation.

2.1 Variation in the data

There is a large variation in the data obtained by previous research as seen in the graph in Figure 2.1. This shows the walking velocities obtained in previous research as a function of density. The differences in the data obtained may be due to the different crowds that have been analysed and the different types of locations that the data was collected from. In all of the research it can be seen that there are specific areas on the graph that can be considered important. The first area where the density is between 0 and 1 person/m^2 is the area where the individuals that are present are becoming less affected by the presence of other individuals and a constant velocity is approached. This velocity can be considered the free walking velocity of the individuals present. The velocity can then be seen to decrease rapidly as the density increases and a zero velocity is approached. The maximum density that can be obtained by packing people is around 7-8 persons/m^2 though this depends a lot on the body sizes of the individuals present which in turn, as suggested by Predtetschenski and Milinski [Predtetschenski & Milinski, 1969] is also affected by the season due to the amount of clothing that will be worn.

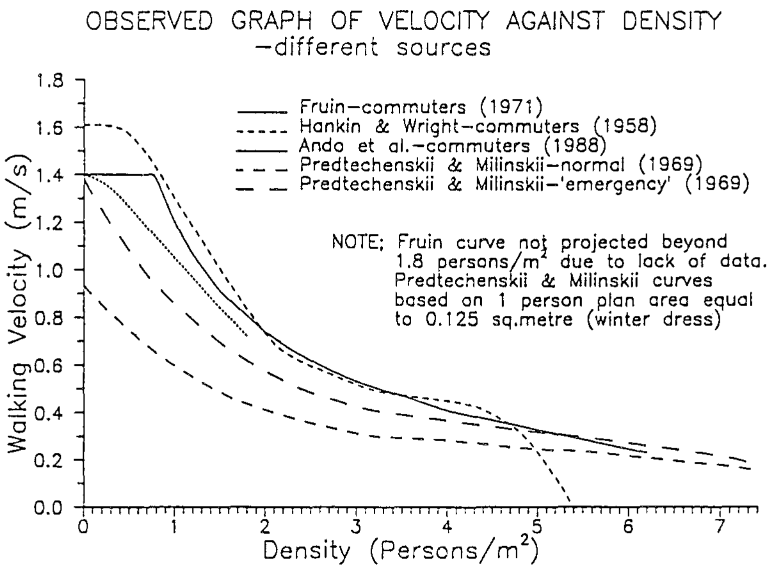


Figure 2.1. Graph of Velocity Versus Density [Thompson, 1994]

2.2 Why is new data needed

The development of new computer models such as Simulex where the individual occupants movement is modelled has brought about the need for new data to be produced. The new data required is to find the movement velocity of the buildings occupants as a function of the interperson distance. Another aspect of individual movement that requires more data so computer modelling can be made more accurate, is the maximum turning rate or body twist of the individuals.

Most previous studies have found the velocities as a function of density and this will in turn treat the occupants as a crowd rather than individuals when using the results for evacuation calculations.

One of the main reasons that there has not been much data collected that relates velocity to interperson distance is that the data collection methods would have been difficult and the computer power required to use this data for an evacuation model was not readily available. Only recently with the advancement of computing power and the availability of image analysing packages have these studies been undertaken.

Time lapse photography could have been used but would have required manual calculations which would have been excessively time consuming.

2.3 Interperson Distance verses Density

Most of the previous studies that have been done have found the various movement velocities and flow rates as a function of the crowd density. This velocity or flow rate finds the total flow rate or velocity for the whole crowd and has not investigated the movement of each individual in the crowd.

To find the movement velocity of the individuals present in a situation we need to find the movement velocity as a function of the interperson distance. The computer model Simulex uses this distance to obtain the movement velocity of each individual separately.

The orientation and the distance between individuals and solid objects are crucial for the accurate simulation of individual motion and behaviour. Interperson distance seems to be more suitable when assessing an individual's velocity. Each person can be assigned their own speed and this speed can change as the surrounding conditions change such as a queue forming or the presence of a slower individual both of which will decrease the interperson distance and thus the individual will slow down.

The area that is of most importance to each individual 'assessing person' is the forward projected area.

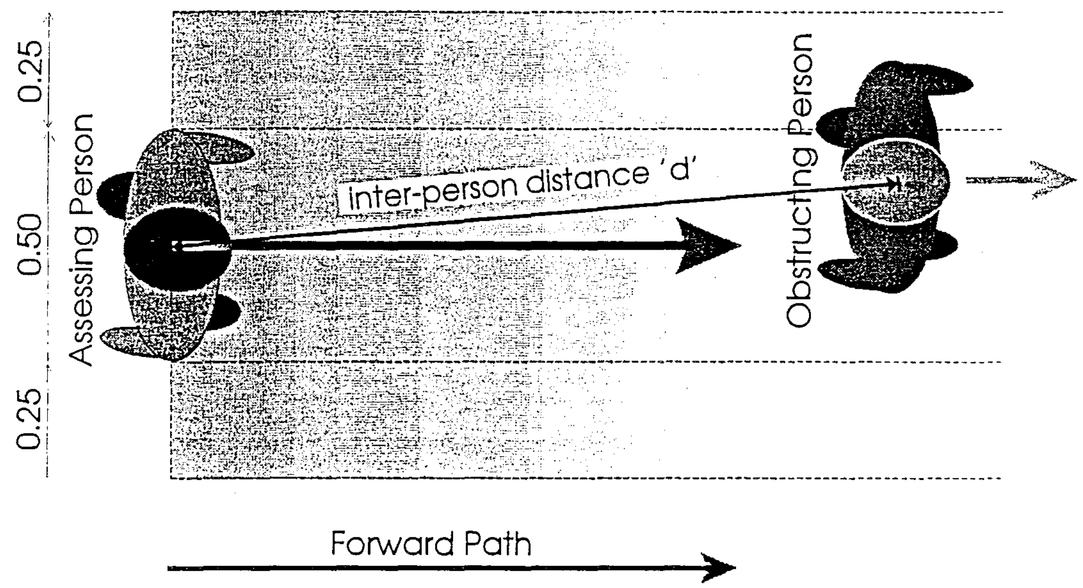


Figure 2.2. The Definition of Interperson Distance 'd'. [Thompson, 1994]

This area is analysed for the presence of an obstructing person. The above figure shows the way the algorithms in the computer model Simulex are used to analyse the area in front of each individual into which they are intending to move. [Thompson, 1994]

2.4 Translating Density to Interperson Distance.

As mentioned before most of the previous data obtained related the movement velocities and flow rates to the density. To compare my results to these it is necessary to convert the density to an interperson distance. In order to make this translation it is necessary to make the assumption that the spacing between the individuals was equal in all directions. The assumption that these distances are equal is not strictly correct. In a real life crowded situation the people present are not in such an ordered pattern. Though it is a simple method of changing the density to an interperson distance and will give a reasonable comparison [Frantzich, 1996]. The equation used in this relationship is:

$$\text{Distance} = \frac{1}{\sqrt{\text{Density}}} \qquad (1)$$

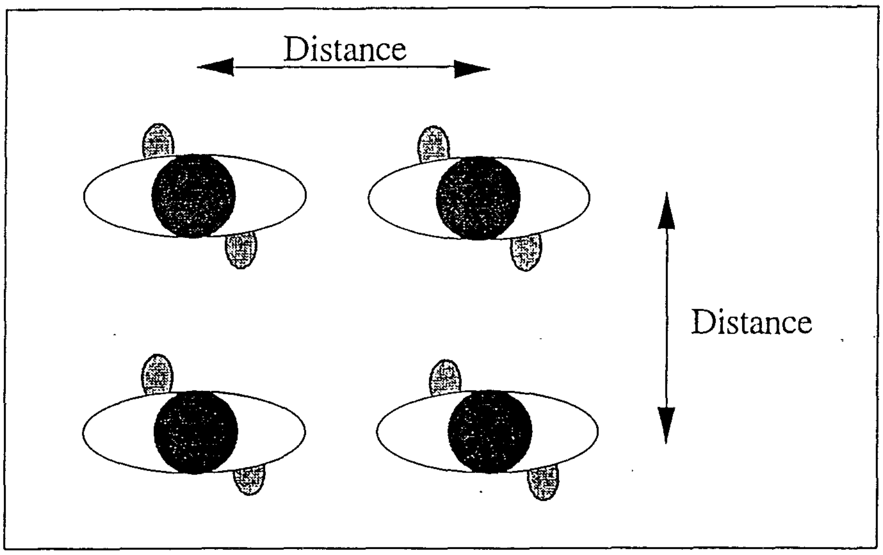


Figure 2.3. Diagram showing the assumption about the Spacing of individuals [Frantzich, 1996]

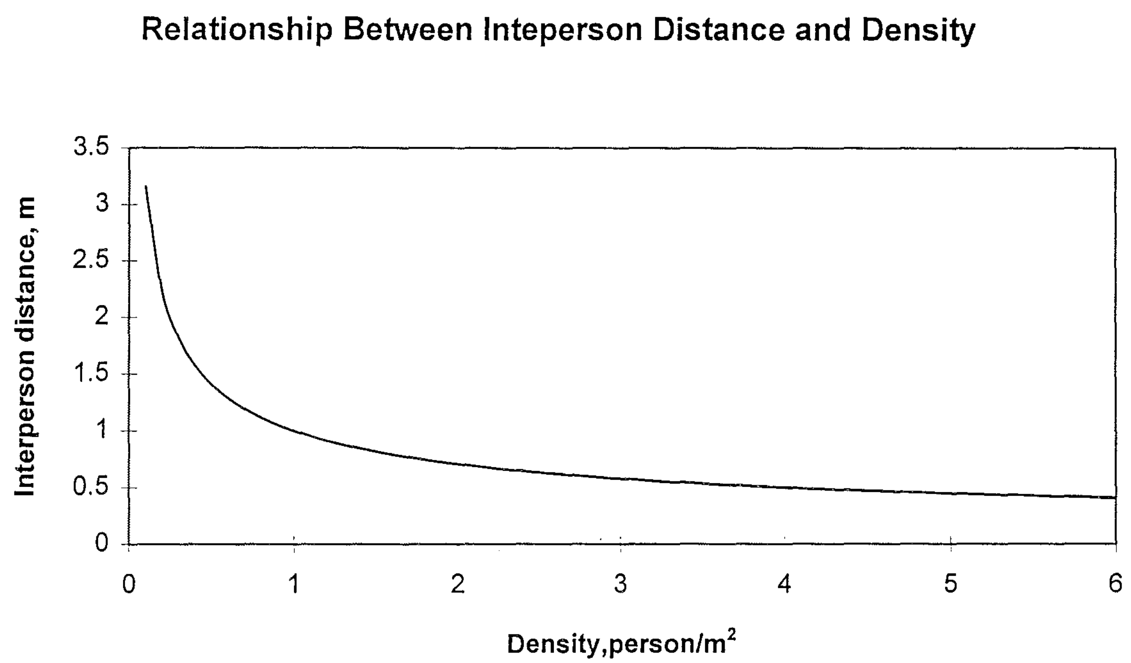


Figure 2.4. Relationship between Interperson Distance and Density

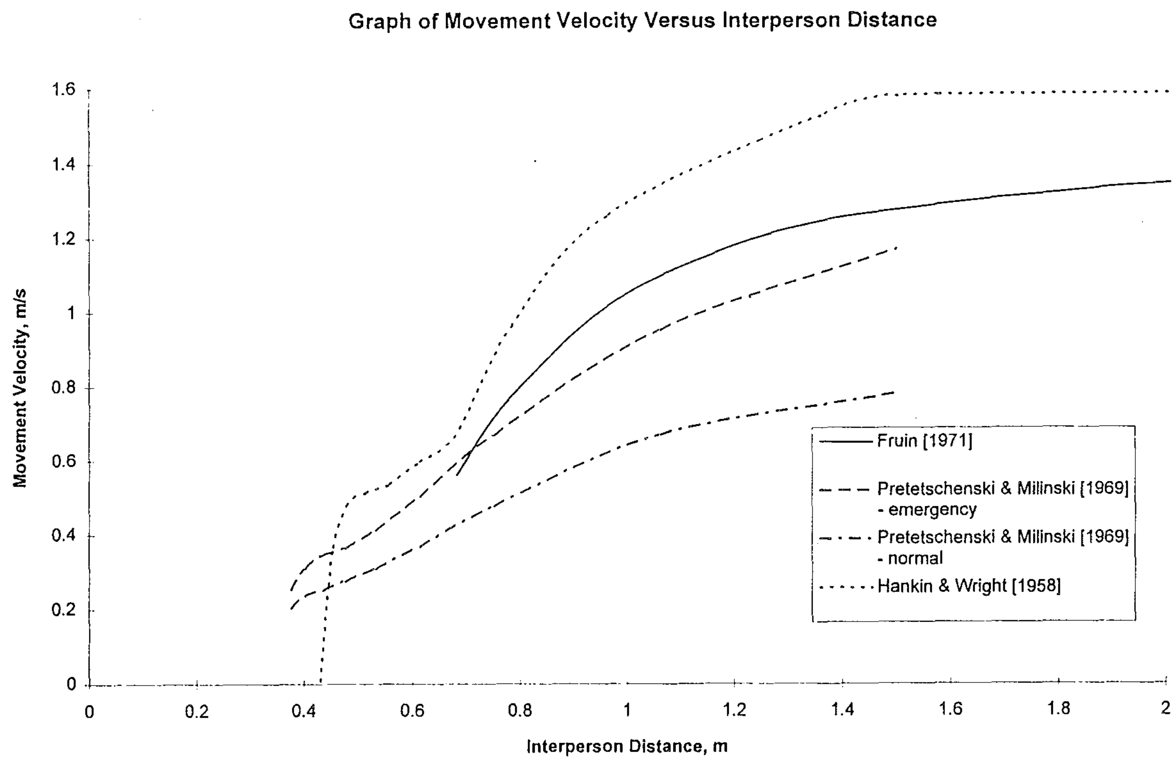


Figure 2.5. Graph of Movement Velocity versus Interperson Distance

3 EARLIER STUDIES

There have been a number of previous investigations with the purpose of studying evacuation movement. Included in these studies was analysis on the movement through doorways and corridors. While there has not been much data collected about movement around corners many of the researchers mention it and suggest that there is not much change in the velocity if confronted with a corner.

There have been many different techniques used to study evacuation movement and the data has been collected using a variety methods. Data has been collected using a stop watch, time lapse photography, video filming and general observations. In recent years due to the rapid advancement in technology the methods of data collection have become less time consuming, easier and more accurate.

The primary characteristic that has been found in the previous studies is the maximum flow rates that are achieved through various building components such as corridors, stairs and doorways. These flow rate were the basis for design in many building codes. Over the last 20 years as computers have become more accessible many crowd movement simulation models have been developed and have become increasingly complex as the computing power available has increased.

Only a few of the previous studies are mentioned here. The investigations that are presented are:

- Fruin (1971)
- Predtetschenski and Milinski (1971)
- Peschl (1971)
- Hankin and Wright (1958)

3.1 Fruin (1971)

Fruin's book "Pedestrian Planning and Design" covers a great deal of work about crowd movement. Most of the studies in the book were based on the movement of commuters and shoppers in bus and train stations and on the city streets. The book covered many aspects of pedestrian flow including the effect of crowd density on walking velocity, the flow of pedestrians per unit width of passageway, pedestrian queuing, the body ellipse and level of service standards.

The level of service concept which was initially developed in the field of traffic engineering was introduced in this book for pedestrians and relates the density of the pedestrians to the walking velocity. The basic principle is that as the density of the traffic increases, the ability of each individual to choose their desired walking speed decreases and the ability to bypass slow moving pedestrians is also decreased. Therefore as the density is increased the level of service is lower. Fruin related the pedestrian density to the walking velocity on horizontal surfaces.

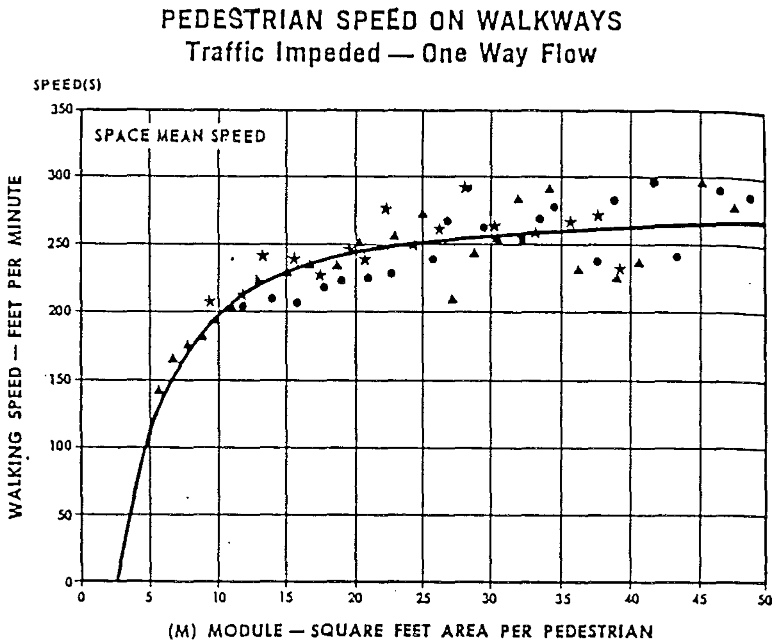


Figure 3.1. Walking Velocities as a Function of Density, [Fruin, 1971]

The graph above shows the effect of increased traffic density on pedestrian walking velocities for one directional commuter traffic. Fruin also noted that in similar studies of two directional and multi directional flows, the results only varied slightly from the curve shown.

The body ellipse and personal space were some others aspects that Fruin covered in his study. The body ellipse is a measure of the human body dimensions, body depth and shoulder breadth. Shoulder breadth is an important factor that affects the capacity of doorways, corridors, stairways and other building components.

From a large amount of data it was found that the 99th percentile shoulder breadth of civilian men was 52.6 cm. The body ellipse that has been used to determine the practical standing capacity for New York city subway cars is an 18 by 24 inch (45.7 by 61.0 cm) body ellipse.

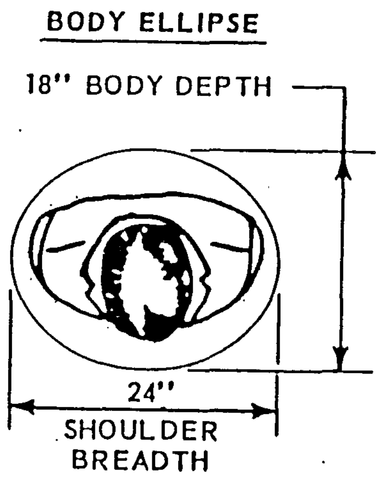


Figure 3.2. The 'Body Ellipse', [Fruin, 1971]

The following figures by Fruin illustrate the various levels of pedestrian area occupancy. In Figure 3.3., the 12" radius or touch zone corresponds to an area of 3 square feet per person. Here, contact between the pedestrians would be unavoidable and the crowd movement would be restricted to shuffling.

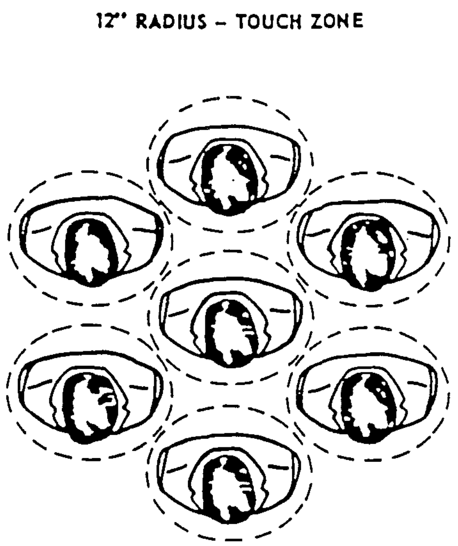


Figure 3.3. Pedestrian Queuing, 12" radius - Touch Zone, [Fruin, 1971]

Figure 3.4. represents the no touch zone or 18" radius this corresponds to an area of 7 square feet per pedestrian and contact is avoidable as long as movement is not necessary. Movement is possible as a group. This is the density of pedestrians that actually corresponds to the maximum flow capacity for walkways and for stairs as established by Fruin.

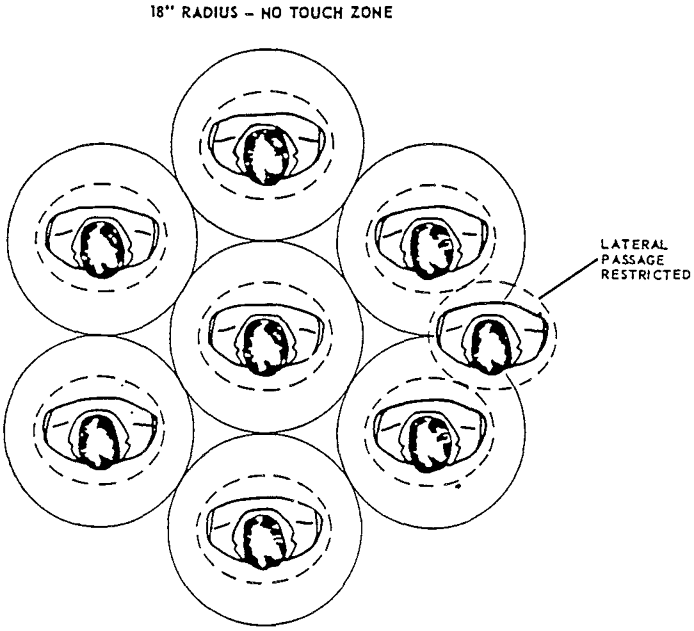


Figure 3.4. Pedestrian Queuing, 18" radius - No Touch Zone, [Fruin, 1971]

Figure 3.5. represents the personal comfort zone or 21" radius. This is the distance selected by people in experiments when choosing a personal comfort distance. Limited lateral circulation is possible.

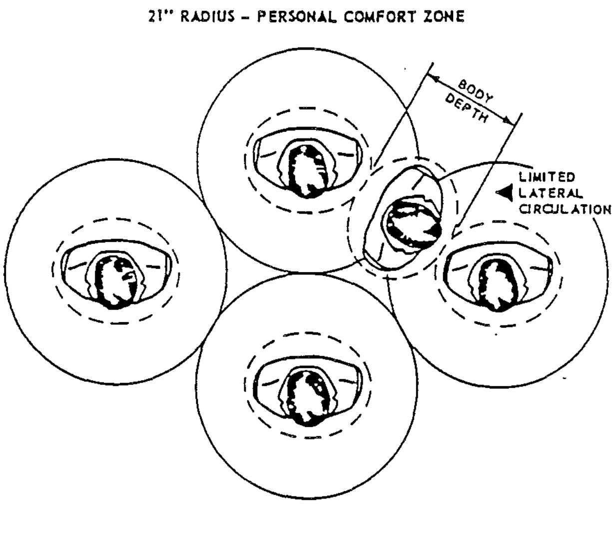


Figure 3.5. Pedestrian queuing, 21" radius - Personal Comfort Zone, [Fruin, 1971]

In Figure 3.6. the area has been expanded to a 24 " radius which corresponds to a 13 square foot area. This is termed the circulation zone as circulation between pedestrians is possible without interfering with others.

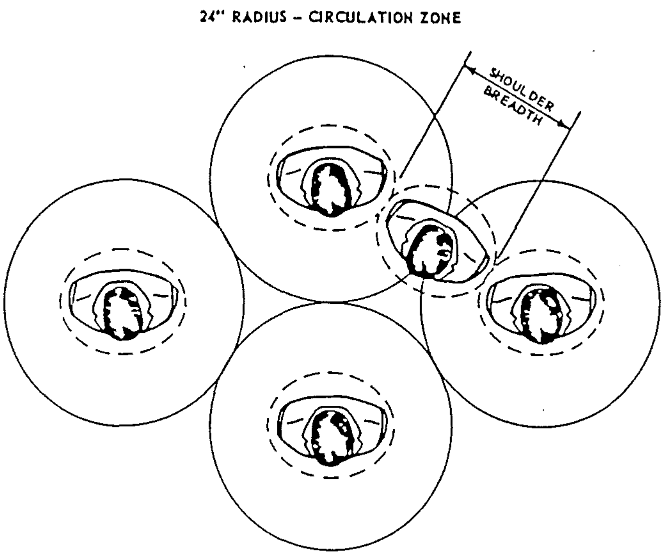


Figure 3.6. Pedestrian queuing, 24" radius - Circulation Zone, [Fruin, 1971]

3.2 Predtetschenski and Milinski (1969)

The studies done by Predtetschenski and Milinski covered movement both horizontally and on stairs. The movement velocities obtained are the result of extensive investigations which resulted in a large amount of data. The main difference in the work by Predtetschenski and Milinski to that of work carried out elsewhere is that of the density measurement. This study used density measured as metres squared of projected body area per metre squared of floor area as opposed to Fruin who used square feet of area per person. They also produced data on the different projected body area for different situations. This included the differences in projected body area from summer to winter due to the extra clothing and for children and people carrying objects.

The velocities and flow rates obtained are shown in Figure 3.7. (The relationship between velocity and density) and Figure 3.8. (Flow rate as a function of density).

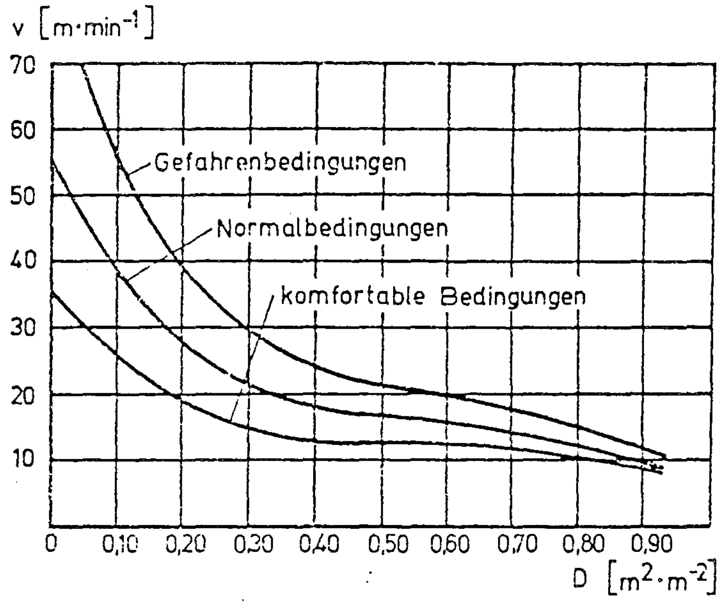


Figure 3.7. Graph of the Relationship Between Crowd Velocity and Density, [Predtetschenski & Milinski, 1969]

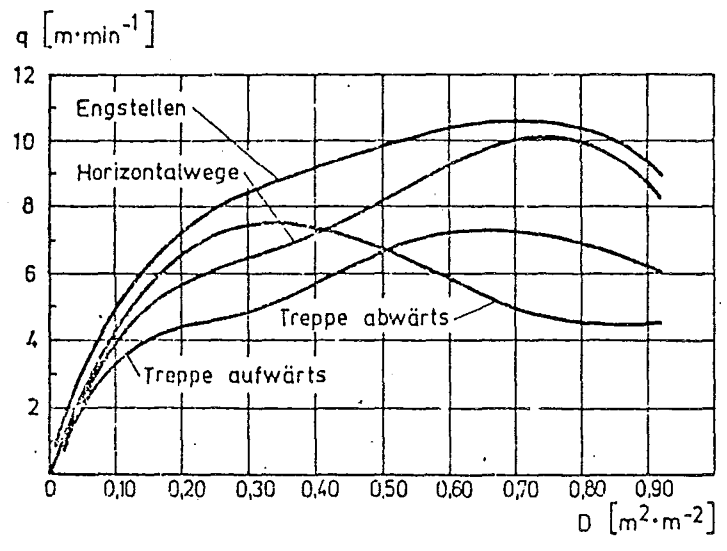


Figure 3.8. Graph of the Relationship Between Crowd Flow and Density, [Predtetschenski & Milinski, 1969]

3.3 Peschl (1971)

Peschl did a lot of work on the flow capacity through doorways. He carried out experiments that involved students circulating around a corridor system that varied in width and had different door openings. At high densities he observed blockages in the system when many of the students attempted to pass through a doorway at the same time. This would lead to a body arch as shown in Figure 3.9.

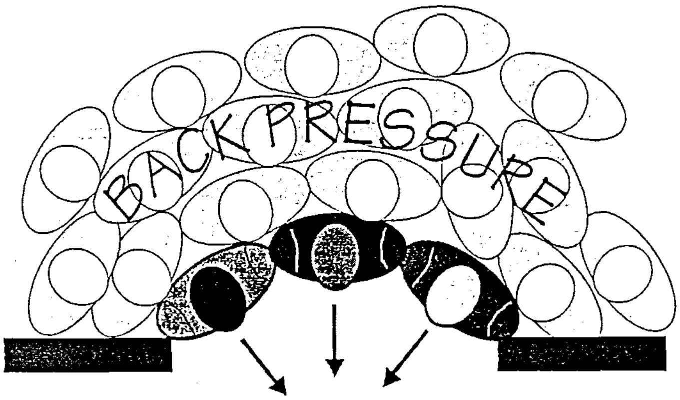


Figure 3.9. The 'Body Arch' [Thompson, 1994]

This body arch, when formed, prevented the continuous flow of occupants through the doorway. Instead a pulsating flow was observed. The arch forms and causes a blockage in the system. The arch will finally manage to break and there will be a release flow through the doorway until another arch in formed. This arching effect was also observed by Predtetschenski and Milinski when the occupant density approached $0.92m^2/m^2$

3.4 Hankin and Wright (1958)

Hankin and Wright performed two sets of test for London Transport the first of these tests consisted of an experiment using 200 school boys who were asked to walk around a circuit that was held up by other students. In this experiment velocity measurements were obtained with the crowd at varying densities and at different passage widths. These experiments were used to get a better understanding of the relationship between crowd density, flow rate and movement velocity. The data that was collected during these experiments were used to develop the shape of the graphs for the data that was collected in experiments that were undertaken later.

The second test was performed at the London Underground and involved two observers collecting the data on flow rates and movement velocities. From the data that was obtained here the following graphs were derived.

See Figures 3.10 and 3.11.

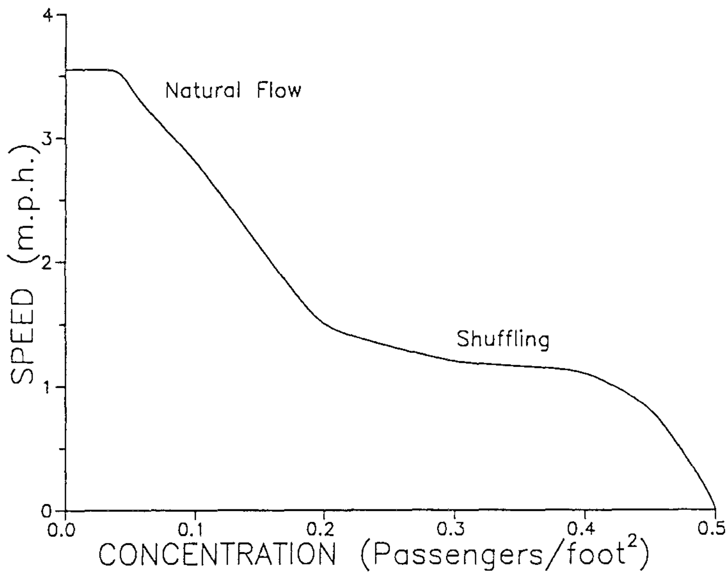


Figure 3.10. Graph of Speed Versus Concentration [Thompson, 1994]

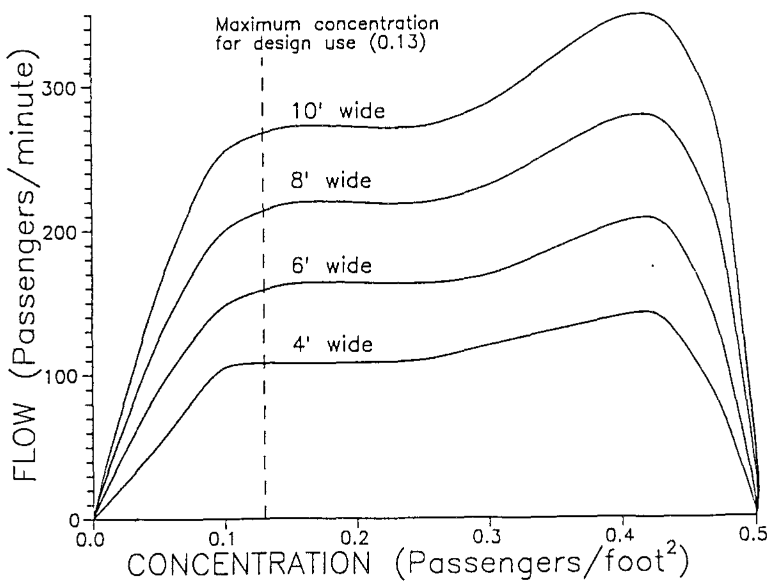


Figure 3.11. Graph of Unidirectional Flow Rate [Thompson, 1994]

4 EXISTING COMPUTER MODELS

The evacuation models that have been developed in the 1970s and 1980s are all of the network node type of modelling. More advanced computer models are currently being developed some of these being more complex versions of the network node type model. These models vary greatly with some designed to handle large numbers of people and concentrates more on the physical flow capacities of the evacuation routes and building components. Others handle smaller numbers of people and attempt to model the movement of people through the building while taking into account behavioural aspects of the occupants as they are escaping.

Some of the existing computer models are briefly described in this paper

They are:

- Exitt
- Evacnet+
- Evacsim
- Exit89
- Exodus
- Simulex

4.1 EXITT [Levin B. M., 1987]

The Exitt computer model is a model that simulates the occupants decisions and reactions in small residential buildings. This computer program was the first evacuation model to be incorporated into the HAZARD 1 package. The computer program attempts to model occupant response and behaviour in a fire situation. When assigning decisions and response to the occupants the computer program was designed to take into account the occupants characteristics such as age, sex, whether the occupant is awake or asleep, smoke conditions, whether a smoke detector is sounding and how loud it is. The actions the individual could take are to investigate the fire, alert and assist other occupants and escape or evacuate the building.

The computer model Exitt is a network node model where each room in the building is represented as a node joined by links or the distance between adjacent nodes. The occupants will then move from node to node at a speed which is both a function of their normal travel speed, smoke conditions and whether or not they are assisting other occupants. The output received from this program consists of the movement and the decisions of the occupants while they are evacuating. The path the occupants take when evacuating is determined by the shortest path algorithms which have the option of assigning penalties for evacuating through bad smoke or for exiting through windows. The program uses the output from the other models incorporated into HAZARD 1 to find when the smoke toxicity effects the occupants and finally calculate when each node is unable to be passed as death would occur. When each link becomes too dangerous, all the optimal routes are then recalculated so that that link or node is avoided.

4.2 EVACNET+ [Kisko T. M., Francis R. L., Noble C. R., 1984]

The computer model Evacnet+ is a network node model. This entails modelling the building as a set of nodes connected by arcs. The nodes represent the various building components such as rooms, corridors, stairs and landings. The arc represents the viable passageway between two of the existing nodes. The arc distance is usually measured as the distance from the centre of one node to the centre of an adjacent node. The program will then identify an optimal plan to evacuate the defined building in the minimum amount of time. Therefore the people are evacuated as quickly as possible. This is done using an advanced capacitated network flow transshipment algorithm, a specialised algorithm which is used in solving linear programming problems with a network structure and will achieve the optimal escape route for each occupant.

Behavioural aspects are not modelled by Evacnet+. The only actions that are modelled by Evacnet+ are the actions that lead to the minimum evacuation time of the building.

The output of Evacnet+ includes the average time spent by the occupants in a particular queue, the average flow rate of each building component, the average length of queues that are formed, the average number of people that are waiting to enter a building component and the percentage of the total evacuation time that each particular building component is in use.

Evacnet+ provides us with detail about the evacuation process at each time step and is therefore a useful tool that can identify to the designer areas within the building where bottlenecks may occur.

4.3 EVACSIM [Drager K. H., Lovås G., Wilkund J., Soma H., 1992]

The computer program Evacsim (Evacuation Simulation System) studies the evacuation movement in mustering situations. It simulates the movement of people from selected areas until they reach a designated mustering area. The program can be used for the design of ships, offshore installations or buildings where the mustering area can be a designated area aboard the ship or offshore installation or an area outside the final exit of a building. The program is also a network node model and takes into account factors such as queuing and bottlenecks. The nodal capacity is set at 4 people per square metre and if a particular node is full, the occupants in the adjacent node are made to wait. The links or arcs between the nodes are the distance between the centre of each node and are given a particular width which is the important parameter of each link as it will give the flow rate of people through that particular link.

A delay time can also be specified by the user to simulate the reaction time of the occupants. The output that is obtained includes how long people take to reach the exits, the time history of each exit, how many people used each exit, the number of people at each node at each time step, and the expected fatalities.

4.4 EXIT89 [Fahy R. F., 1991,1995]

The computer model Exit89 was developed on the same basis as Exitt but was able to handle a large number of occupants. The program is capable of handling up to 700 occupants. Also each floor of the building was able to have up to 89 nodes. Exit89 does not include all of the behavioural aspects available in Exitt due to the fact that the population of a high rise is too great to handle. That much detail for each occupant and the behaviours such as investigation and rescue are considered not as relevant in the larger more impersonal buildings.

Exit89 requires the buildings information to be inputted as a network with dimensions of each room and openings, distance between the nodes and the number of occupants initially located at each node.

Exit89 uses the walking speeds that are calculated as a function of density. These walking speeds are calculated using the data from the work of Predtetschenski and Milinski. As mentioned is section 3.2, the density is measured as metres squared of projected body area per metre squared of floor area. The projected body area that has been used in these calculations is $0.113m^2$ or the mean dimensions given by Predtetschenski and Milinski for an Adult in mid seasons dress. Subsequent work by Ezel Kendik using Austrian subjects found the body dimensions of $0.1862m^2$ for adults wearing coats and $0.1456m^2$ as the mean body dimension The mean body dimensions obtained from Occupational Safety and Health in Business and Industry for U.S. male and female workers aged between 18 and 45 gives the horizontal projected body area of $0.0906m^2$. These other sources give mean projected body areas that differ greatly from the ones suggested by Predtetschenski and Milinski. The choice between the three different sets of data is an option that can be set by the user. The model does not calculate the walking speeds of each individual but calculates the average speed of the crowd at each node that is based on the crowd density.

This model will also calculate the optimal route for each of the occupants in the building or, if desired by the user, can follow a specified path which could be a familiar route. The computer program can also use smoke data that can be obtained from programs such as CFAST and from this can determine when certain nodes will become blocked (these nodes will then be removed from the network) and the occupant's escape routes will be recalculated.

A study evaluating the computer model Exit89 found some problems with this program. [H Persson, 1996]. These problems included having the option to choose the body size between the different sets of data that are available. The average body size in these three sources vary greatly and it is impossible to tell which source is correct without further research. The value of the body size is not a very important factor and the evacuation times don't differ too much when using the different sizes. The main problem with the program is the evacuation speed. The evacuation speed in Exit89 depends only on the density of the occupants in each node or room. By using this method to evaluate the speed we get evacuation times that are completely independent of the door widths between the nodes. This gives some strange results when passing through narrow openings between two nodes. Due to the fact that the evacuation speed is independent of door size, the same evacuation time would be found if the door was 1 metre wide or if the door was 3 metres wide. This result may be acceptable when the occupant density is low and there is no queuing at the door but at higher densities when a queue is formed, the results obtained will be wrong as the evacuation times obtained for the 2 different door sizes should not be the same. Another problem is that Exit89 moves the occupants as crowds so if a node becomes blocked Exit89 will not allow anyone to pass even if a few of them may have managed to pass before the node became blocked. Exit89 therefore has problems that need to be fixed before it is used in the design of a building.

4.5 EXODUS [Galea E. R., Perez Galparsoro J. M., 1994]

The computer model Exodus is intended primarily to model the evacuation of mass transit vehicles such as aircraft but can also be used for other situations that have a similar layout with rows of seats and aisles such as cinemas, theatres and lecture halls.

The model tracks the individuals as they make their way out of the enclosure or until they are overcome by the fire hazard. It consists of five core interacting components which consist of movement, behaviour, passenger, hazard and toxicity submodels and while a simulation is being performed all or some of these submodels may be active. As with most other evacuation models this is a network node model though the size of the nodes have been greatly reduced for more accuracy. The movement of each individual is followed from one node to the next and only one conscious individual may occupy a node at any one time. If an unconscious person is present at the node the obstacle value of that node is increased therefore making traversal of that node longer.

The occupants in this model are all treated as individuals and are each described by a collection of 22 attributes which define both their physical and psychological state as well as their progress through the aircraft. Their are 13 defining variables and 9 progress variables. The 13 defining variables include name, sex, age, weight, condition, mobility, agility, travel speed, volume of air breathed, incapacitation dose, response time, drive and patience. Of the 9 progress variables 7 represent a measure of the passengers exposure to narcotic fire gases and convective heat.

The travel speed for each individual is assigned as one of four speeds 'run', 'walk', 'leap', and 'crawl' with the appropriate speed being chosen depending on what conditions are present and what terrain they are travelling over. This program is also able to receive data on the toxicity of the air from other programs which can then be used to determine the individual occupants characteristics and mode of movement.

4.6 SIMULEX [Thompson P. A., 1994, 1996]

Simulex is a computer model that has been developed at the University of Edinburgh. This computer model can simulate the evacuation of people from large, geometrically complex building structures. When using Simulex the occupants in the building are all assigned individual characteristics and walking velocities. Each occupant will be assigned a normal walking velocity. This velocity is the speed in which the occupant will move when they are unobstructed. This normal walking velocity is chosen randomly for each occupant and is in the range from 0.8 -1.7 m/s.

The actual walking velocity obtained in the simulation is dependant on the interperson distance or distance between the occupants. As this interperson distance is reduced the occupants velocity will also reduce. This is different from the other computer models that are currently available as they use the density to determine the walking velocity that will be used. Using the interperson distance treats the occupants more as individuals and their velocity changes as the surrounding conditions change.

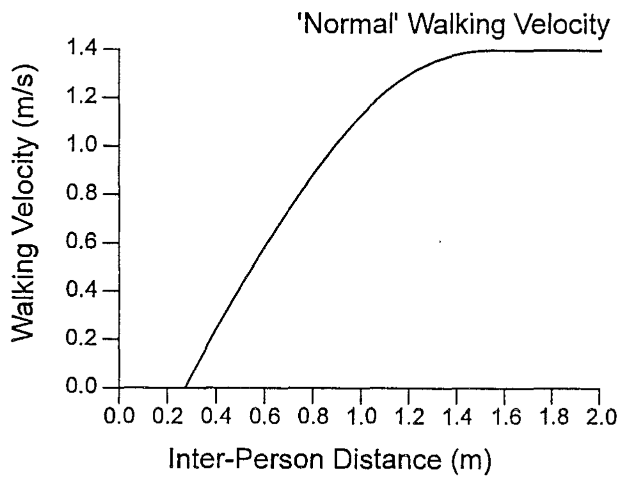
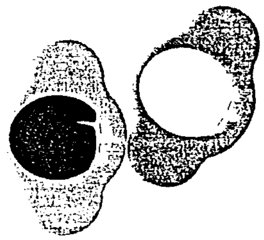


Figure 4.1. Walking Velocity as a Function of Interperson Distance.

Another individual characteristic that is assigned to each of the building occupants is their body dimensions. In Simulex the occupants body dimensions are represented by three circles, a large circle representing the torso and two smaller circles representing the occupants shoulders as shown in Figure 4.2.



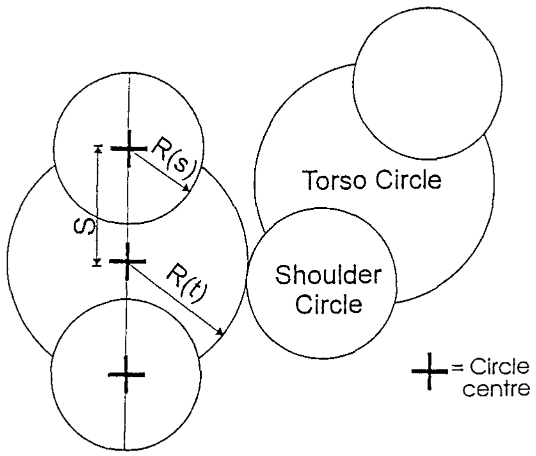


Figure 4.2. Body Dimensions layout in Simulex [Thompson, 1996]

Simulex contains four different body types with different dimensions as given in the table below.

Body Type	R(t) (metres)	R(s) (metres)	S (metres)
Average	0.25	0.15	0.10
Male	0.27	0.17	0.11
Female	0.24	0.14	0.09
Child	0.21	0.12	0.07

Table 4.1. Table giving body dimensions that are used in Simulex. [Thompson, 1996]

The main input that is required for Simulex is a building plan. A CAD drawing is required which just consists of the relevant building shape, all other information such as text, door swing lines that is normally contained on a building plan must be deleted in order to be able to run Simulex. The building contents can also be left on these plans if the exact location of these are known.

The other input that is required is the occupant density, the occupant can be entered in as groups or individual occupants may be placed around the building. This is done by defining an area, then either a density or a number of occupants may be specified for this area.

Once all the input is complete the program may be run. When running Simulex the walking velocity of each occupant is dependant on the interperson distance. As this distance decreases so does the velocity of the occupant. When there is a person in front of someone else, the velocity of the person following will be reduced accordingly. Faster occupants may attempt to overtake and will change their direction to attempt this if following a slower person.

The main output from Simulex is the total evacuation time of the building. Simulex will also be able to show when each part of the building has been evacuated and show problem areas like where bottle necks and queuing is formed.

Simulex has advantages over other existing computer models in that it is able to simulate evacuation from buildings that are geometrically complex. It also has the advantage that the only input that is required is a building plan and the densities of each part of the building. Simulex also treats the occupants more as individuals than the other computer programs by using the interperson distance to find their movement velocity instead of the occupant density which treats the occupants present as a crowd. Another advantage of the Simulex model is that the building evacuation is shown live on the screen enabling the designer to easily see the problem areas such as where bottlenecks and queues are formed.

4.7 SUMMARY

Most of the earlier computer models are of the network node model format. The input required for this type of analysis is a network description of the building. The network describes the building consists of a set of nodes and arcs. The main building components such as rooms , corridors, stairs and lobbies are entered in as nodes with the arcs representing the passageways between these nodes. Other data that has to be supplied to the computer model is information about the nodes and arcs. This information includes node capacity, node initial contents, arc flow capacity and arc traversal time. Once all this information has been entered the computer model may be run.

These network node computer models have the disadvantage that they require a large amount of user input and when the building that is to be analysed becomes more complex the input of the data becomes both time consuming and the modelling less accurate. An advantage of the network node models is the short time it takes to run the simulation after data has been inputted.

Simulex on the other hand has advantages over this type of model due to both the ease of input and the ability to handle more complex building structures accurately. For Simulex the only building input that is required is a building plan in the form of a CAD drawing and the population densities for the whole building or for each room individually. The simulation time may take a lot longer but time is saved on the input. Simulex treats the occupants more as individuals than as a uniform crowd as the other earlier computer programs do, thus the interactions between the occupants themselves and between the occupants and solid objects are more accurately modelled. A disadvantage of Simulex is if there is no CAD drawings available for the building that is to be designed the input is impossible unless a CAD drawing is made which may take a long time.

5 METHOD

The object of these experiments was to obtain the movement velocities of people versus interperson distance.

The experiments were conducted in the fire engineering laboratory and then analysed using a video image analysing technique. This involved filming a video sequence during the experiment. The film is then analysed frame by frame with image analysing software. From the analysis both the movement velocities and the twisting rates for the individuals involved in the experiment can be determined. This technique was developed at the University of Edinburgh, [Thompson, 1994].

The first thing that needs to be done is to set out the test area which is the area where the analysis will take place. The test area rectangle is projected vertically to produce a measurement at average shoulder height, this is assumed to be 1.5m for the test subjects being used.

The corners of the test area are then recorded on film using a grid marker so they can be used later in the analysis software. The video camera is not required to be directly above the test area. The optimal position for the camera is at least one storey above the test area and no more than 40-50m away from the edge. This is so the video camera will be in a position from where the test subjects are well visible for easier analysis. The angle between the video camera and the test area is not important as the video analysis software only requires that the four corners of the test area and its dimensions are known. (See Figure 5.1.)

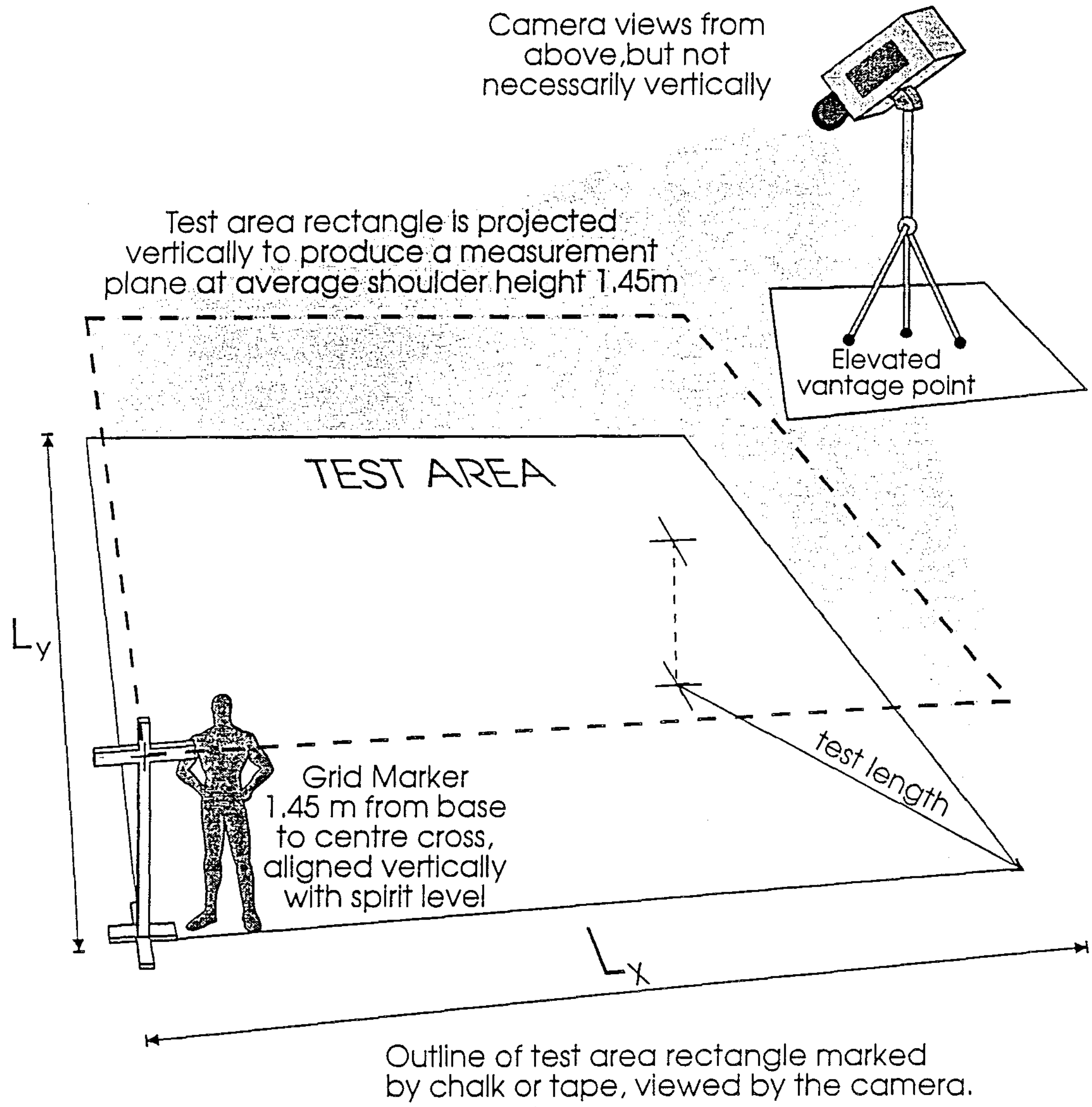


Figure 5.1 Elevated Test Area and the Perspective Rectangle. A grid marker is used to define the test areas corners as a perspective rectangle for analysis. [Thompson, 1994]

5.1 Test Subjects

These experiments have been conducted within the engineering departments building using students as test subjects. The students that have been used have an approximate age interval of between 20 and 30 years and both male and female students have been used. In this group of people the average shoulder height is assumed to be 1.50m. There was no one that had any movement disability and all were fit, young, and healthy adults. The tests that have been conducted therefore have been assumed to determine the normal walking speed of the test group only and not a simulated evacuation speed for everyone or for conditions that may present during an evacuation in a real fire.

It can be assumed that the velocities during an evacuation may be higher than the velocities found during a normal situation. The velocities that are found in these experiments could be roughly assumed to be approximate evacuation velocities for the average adult population.

5.2 Geometrical Description of the Experiments

The position in the laboratory was chosen as it was close to the mezzanine floor which enabled ease of filming during the experiment. The camera has been set up on the floor above the test area in a position where the entire set-up is visible. Note as mentioned before, the angle of the camera from the test area is not an important factor as the frame analysis software Persias only requires to know the location of the four test corners and the test rectangles dimensions.

Once each of the experiments have been set up and the corners of the test area recorded then the experiments may start

5.2.1 Movement Through a Doorway

The corridor and doorway have both been constructed in the engineering laboratory. The test subjects will be filmed as they walk through the various experimental set-ups with different densities. The door widths can also be changed and the behaviour of the test subjects is analysed.

The walls of the corridor have been constructed out of particle board with 100mm x 50mm framing. Each section of wall was constructed separately and was designed so it could be folded away when not in use and could be easily assembled for the later experiments of opposed flow and movement around a corner. The total length of the corridor is 6m which consists of five particle board wall sections on each side. The doorway was positioned at one end 4.8m along the corridor. Figures 5.2. and 5.3. show the set-up and geometry of this experiment. The doorway that was constructed for this experiment was made from 100 x 50 framing. the width of the doorway was able to be changed and door sizes of 700 mm, 850 mm, 1000 mm, 1150 mm, 1300 mm and 1500 mm were constructed. The experiment was also constructed so it can be set-up and dismantled quickly so as not to interfere too much with other activities in the laboratory. To do this many of the main joints, for example the connections between the walls on either side were held together by clamps that could be easily dismantled and then the walls could be stored out of the way for later use.

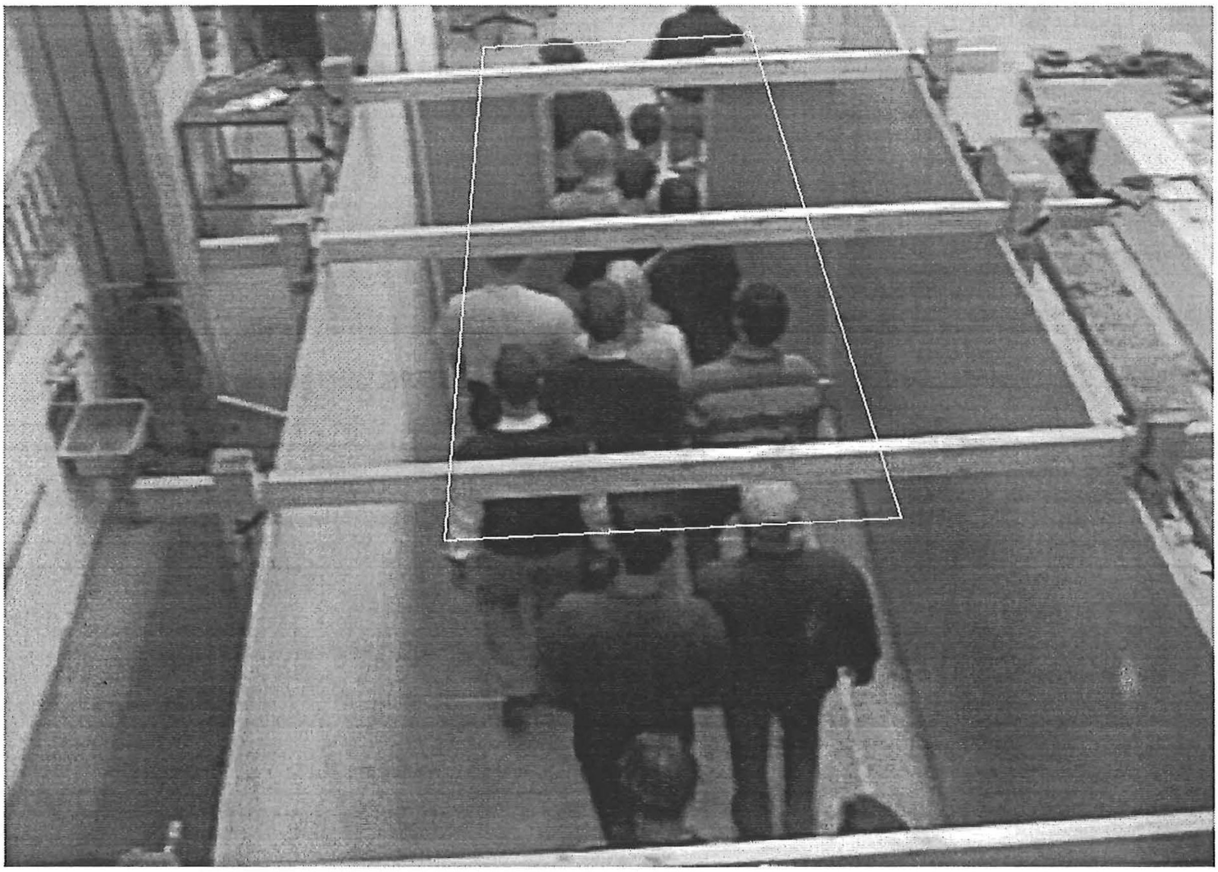


Figure 5.2 Photo of Doorway Experiment also showing the Test Rectangle

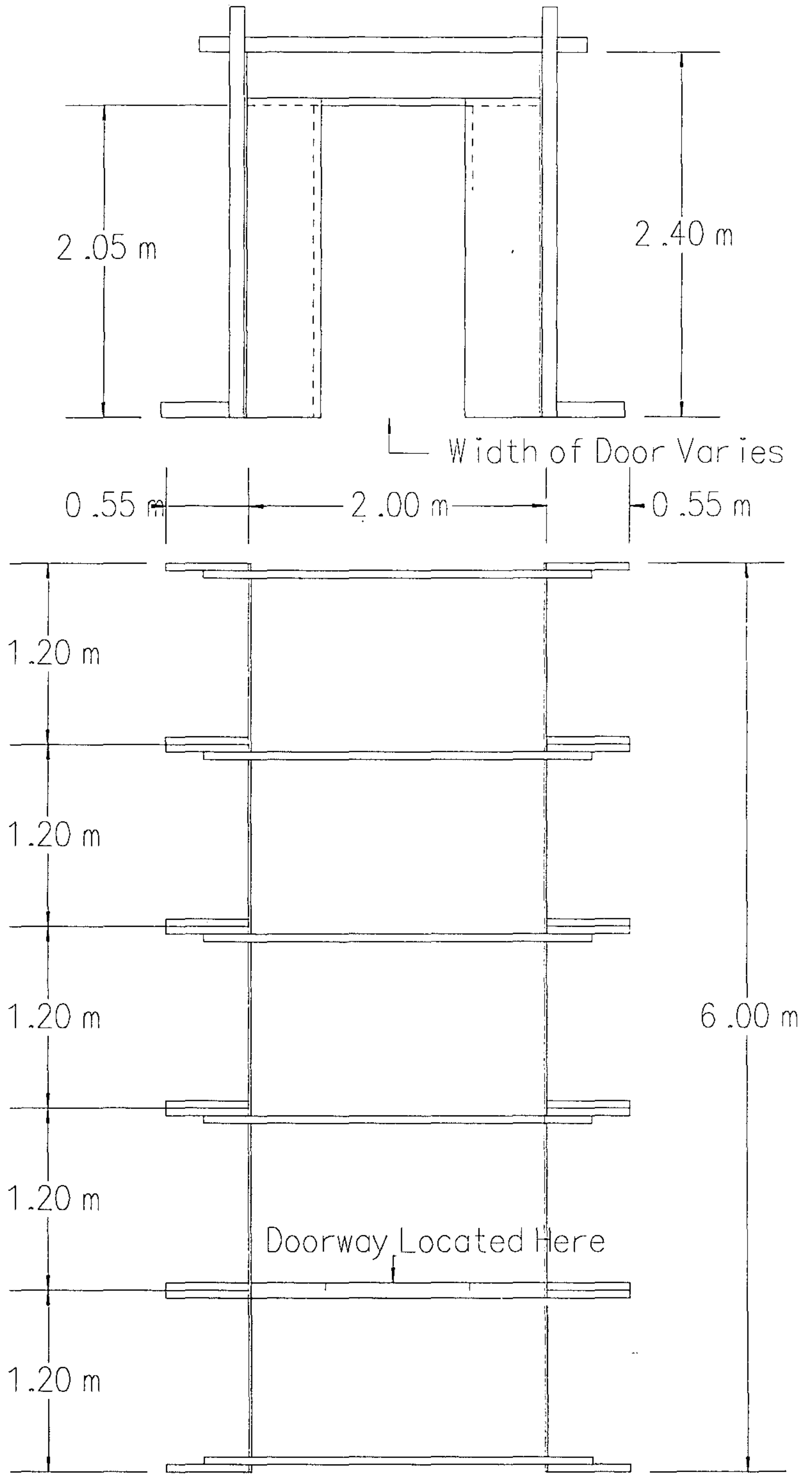


Figure 5.3 Plan and Elevation of the Doorway and Corridor

5.2.2 Movement Around a Corner

This experiment is also conducted in the laboratory. The existing wall sections from the corridor experiments were used for this experiment and moved so as to produce a corner. Again the experiment was set-up in a location in the laboratory where ease of filming and construction was available. Again once the test area has been set and the corners recorded on to video tape the experiment may start.

The corridor was again 2m wide and was made from a total of 12 wall sections 4 on the inside of the corner and 8 on the outside. The following figures show the corner layout and geometry.

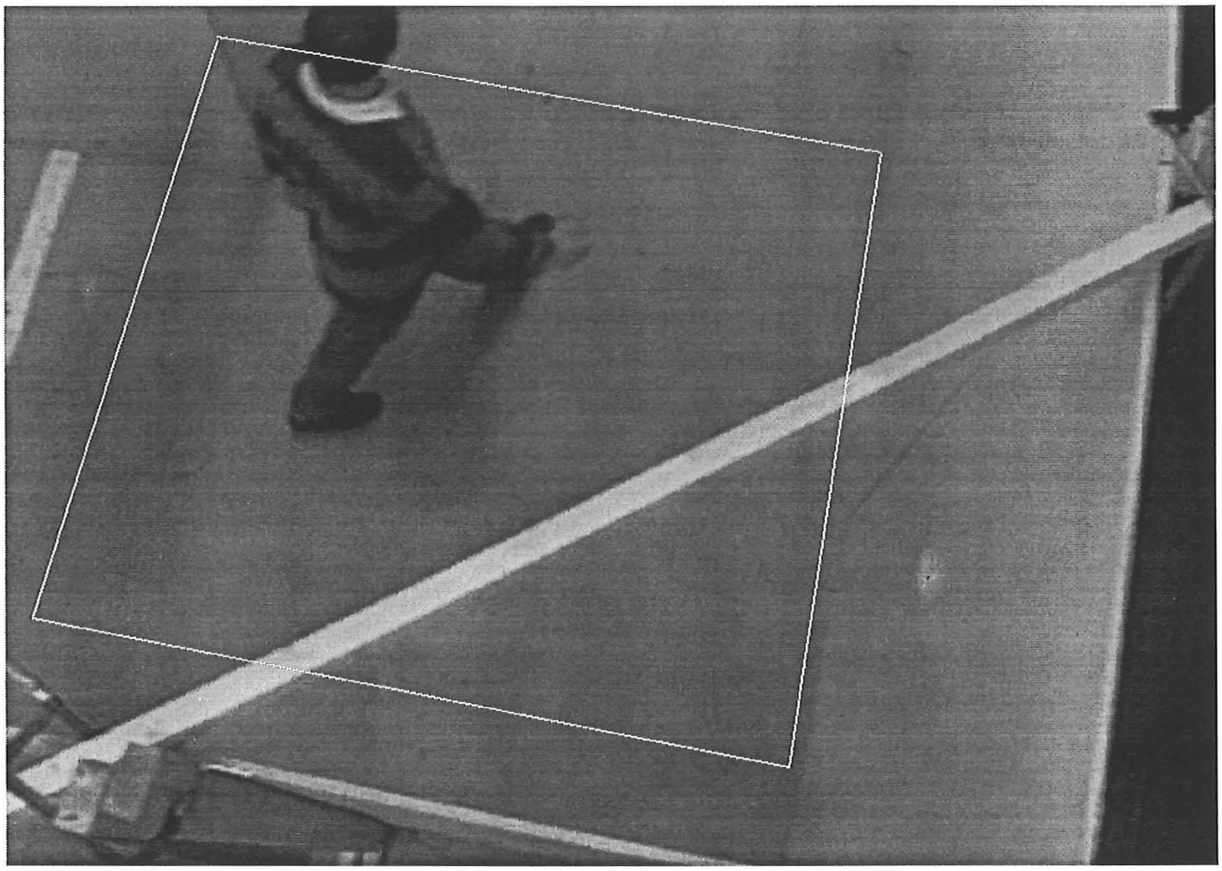
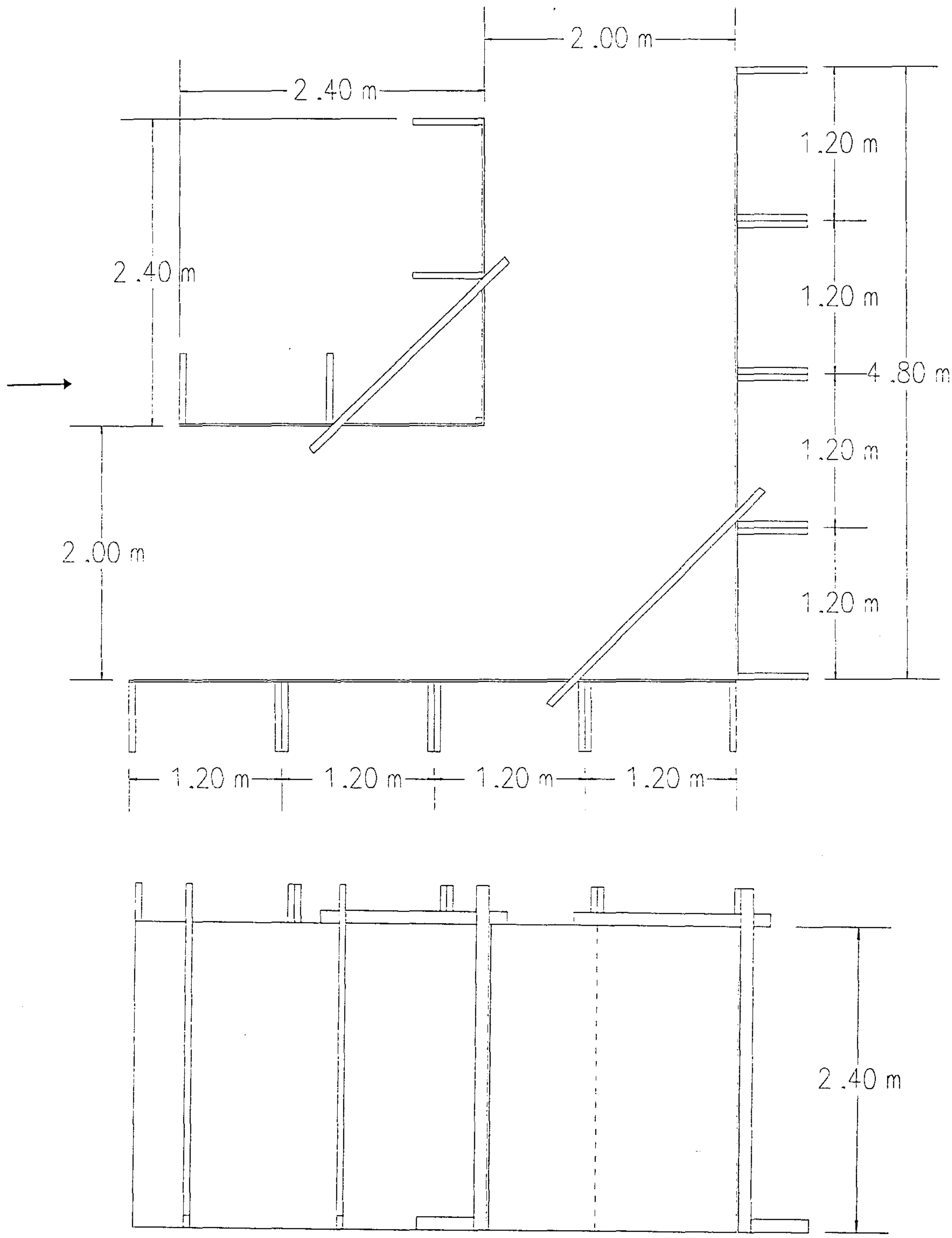


Figure 5.4 Photo of Corner Experiment also showing the Test Rectangle



Elevation viewed from direction of arrow

Figure 5.5 Plan and Elevation of the Corner Experiment.

5.2.3 Opposed Flow

This experiment is also set up in the laboratory using the corridor that was constructed for the doorway experiment though the doorway has been removed. The object is too see how the subjects will react to opposed flow. The camera is set at a height so that the shoulders of all the test subjects can be easily seen. The test area will be set-up in the middle section of the corridor. One or more of the students were asked to move against the main flow thus producing the opposed flow effect.

The corridor was 6m long consisting of 5 wall sections on each side and 2m wide. See Figures 5.6 and 5.7.

Figure 5.6 Photo of Opposed Flow Experiment also showing the Test Rectangle

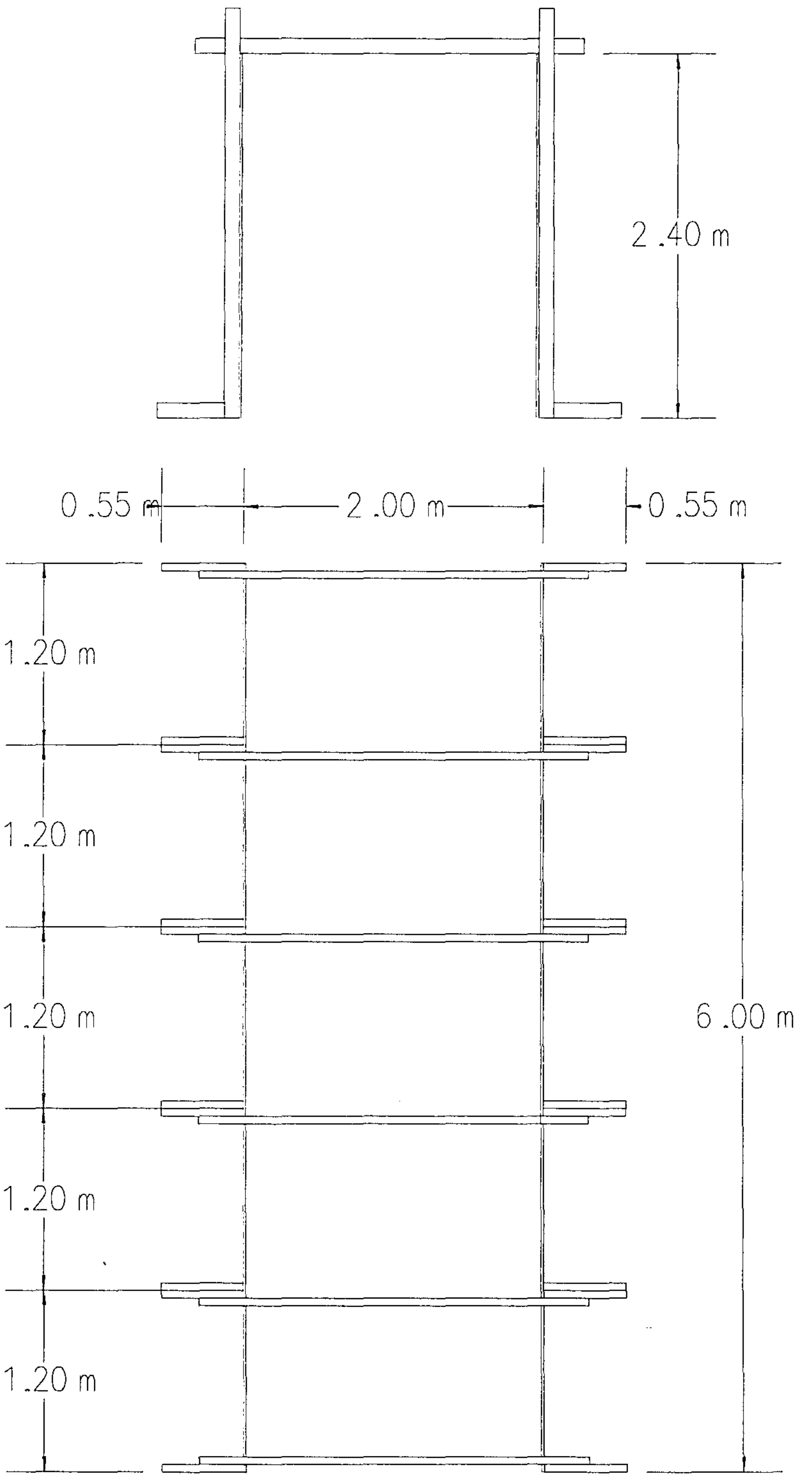


Figure 5.7 Plan and Elevation of the Corridor used for the Opposed Flow Experiment.

5.3 Experiments Performed

In all these experiment the test subjects used were students studying at the University of Lund. During the tests, the students were asked to walk through the experimental set-up in varying densities ranging from a few students to all the students present, therefore a crowded situation with high population density was simulated.

5.3.1 Movement Through a Doorway

In this experiment the test subjects were required to walk down a short corridor toward a doorway which then restricts the flow of the subjects. This forces the subjects to change direction to enable the movement to continue. Also looked at was the change in velocity as the doorway was approached both due to the interperson distance decreasing due to queuing and their proximity to the door itself. This experiment involved using different door widths to see how this affected the movement. The density of the subjects as they walked through the corridor was varied from normal or low densities to a high population density. The density is varied by having the students stand in an area that has been marked out previously before getting them to walk down the corridor. The number of students placed in this area each time the experiment was performed was varied getting the various densities and interperson distances required. The number of students used varied from 5 to around 35 depending on the number that turned up to participate in the experiment. Another aspect that was looked for as described in previous studies on movement through doorways was the arch effect. The arch effect is where under high densities an arch is formed in front of the doorway due to the pressure applied from the occupants behind (see Figure 3.9.). A pulsating flow of people is seen through the doorway when this arch is present. An arch is formed and is then broken and a small flow of people move through the door until another arch is formed.

Experiment Number	Door Width (mm)	Description of experiment
1	700	Low density to high density
2	850	Low density to high density
3	1000	Low density to high density
4	1150	Low density to high density
5	1300	Low density to high density
6	1500	Low density to high density

Table 5.1. Doorway experiments performed

In these experiments the test subjects walked in different configurations in the corridor ranging from just a few persons in the corridor at once up to a large density where all the test subjects were acting as a crowd. Observations were made to see if the arching effect was apparent and how the occupants changed direction to move through the doorway present.

5.3.2 Movement Around a Corner

This experiment involved the test subjects walking around a corner that had been constructed in the fire engineering laboratory. The students were asked to walk through the corridor system and around the corner. The experiment involved sending the students down the corridor at various densities. From each of the experiments the data obtained included the movement velocity as a function of interperson distance and the body twist or rate of turning. The number of students that were sent down the corridor each time varied from 5 to around 40. Therefore the densities that were obtained ranged from low densities to high which simulated a crowded situation.

5.3.3 Opposed Flow

The corridor that was constructed as part of the movement through a doorway experiment was used for this experiment. The experiment involved having the test subjects walk down the corridor while one or more people walked in the opposite direction from the main flow of people. The densities of the main flow varied from low to high densities. Observations were made to see how the test subjects change their direction when confronted with another person approaching them from the opposite direction and whether or not their movement velocity is affected while the other person is passing. The number of people who were walking in the opposite direction was also varied with one person or three people opposing the main flow. An experiment was also performed with half of the test subjects present walking in each direction. The following table shows what experiments were performed.

Experiment Number	Number of People Opposing	Description of Experiment
1	1	Main flow varied from low to high densities
2	2	Main flow varied from low to high densities
3	Half of total number present	The main flow and the opposing flow are equal in size consisting of half the total number of people present

Table 5.2. Opposed flow experiments performed.

These experiments involved the occupants walking in various configurations ranging from a few people to high densities which involved all the test subjects present acting as a crowd in the main flow. Opposing this main flow was one or more occupants whose objective was to pass through the main flow going in the opposite direction. The occupants opposing the main flow were to pass through the corridor using any route possible. The easiest route may not necessarily be straight. Observations were made to see how the occupants movement changes as they move through the main flow of people. Also observed is the movement of people involved in the main flow and how they react to the people who are approaching them in the opposite direction. In the experiment with equal flows in each direction the observations will be whether or not the occupants form rows or not as they move from one end to the other as would be expected as well as velocities, flow rates and turning rates.

5.4 Method of Analysis

5.4.1 Video Capture

The video of each of the experiments initially had to be converted from the video film into computer files in the standard video for windows AVI format. This is done using a video film capturing package called Movie Machine Pro from Fast electronics in Germany [Fast Electronic GmbH, 1994].

Movie Machine Pro is an add-on board for IBM-AT and compatible PC's. Movie Machine Pro captures the video sequence in nearly full PAL resolution, 736 x 560 pixels and approximately 2 million colours regardless of the type of graphics card installed. The Movie Machine Pro package was designed specifically as a Microsoft Video for Windows frame grabber. The captured video sequences can be played back on any computer without additional hardware. The Movie Machine Pro software also includes a video capture driver which can be installed with Microsoft Video for Windows and can record video sequences off an external video source at up to 25 frames per second.

The files that are captured in the movie machine capture driver are quite large. The files were therefore compressed using the M-JPEG Option [Fast Multimedia AG, 1995]. This enables the files to be reduced to a reasonable size to be stored on the computers hard disk. The compression of the files may have a negative effect on the image quality of the video. However for these purposes the images obtained are sufficient.

In order to minimise the file size more and for ease of analysis the number of frames captured varied. The capture rate for the initial set-up where the test area and test points are defined was one frame per second. The capture rate was then set at four frames per second for the analysis of people movement through the various experimental set-ups.

5.4.2 Using Persias

Now that the video footage has been saved as a computer file in AVI format, the computer analysis can begin. The computer program used for the movement analysis was Persias, developed at the University of Edinburgh. Persias is a software tool which enables the user to analyse the motion of points or areas identified on a video for windows AVI movie file. [Thompson, 1995].

The first thing to do using Persias is to load the AVI file which contains the corner and test point locations. Then using the perspective command and functions define the perspective rectangles corners. Also it is necessary to check the location of the test points to check the accuracy of the Persias display. The perspective rectangle is then saved onto a computer file.

The next step is to load the AVI file containing the experimental footage. This file may be the same as the file that defines the perspective rectangle. The saved perspective rectangle will have to be reloaded at this point.

The T-shaped markers are used on the video images to follow the test subjects. From the various locations of these markers which are moved every frame it is possible to determine different parameters of the test subject. In this case we are interested in the velocity and maximum turning rates of the test subjects.

The data that is obtained from this analysis is stored on a spreadsheet compatible file which can be opened and used in various spreadsheet programs.

The motion analysis begins by identifying various individuals with the T-shaped markers. These markers are of two types a base marker and obstructing markers. The base marker is placed on the person to be analysed and the obstructing markers will identify the surrounding persons who are close to the base person. The data file will contain the velocities of these markers as well as record the distances from the base marker to the other obstructing markers therefore defining the interperson distance of the test subjects.

To carry out the analysis the first frame is set as the initial data capture frame and the T-shaped markers are positioned on the shoulders of the test subjects. The video is then advanced one frame and in our case this is 0.25 seconds. This frame is then set as the final data capture frame and the T-shaped markers are adjusted accordingly to the new positions of the test subjects. This process is then repeated with the final data capture frame becoming the initial data capture frame and each time step is recorded. As the positions at each time step are recorded the velocities and turning rates are recorded and can be analysed in a spreadsheet program such as MS Excel.

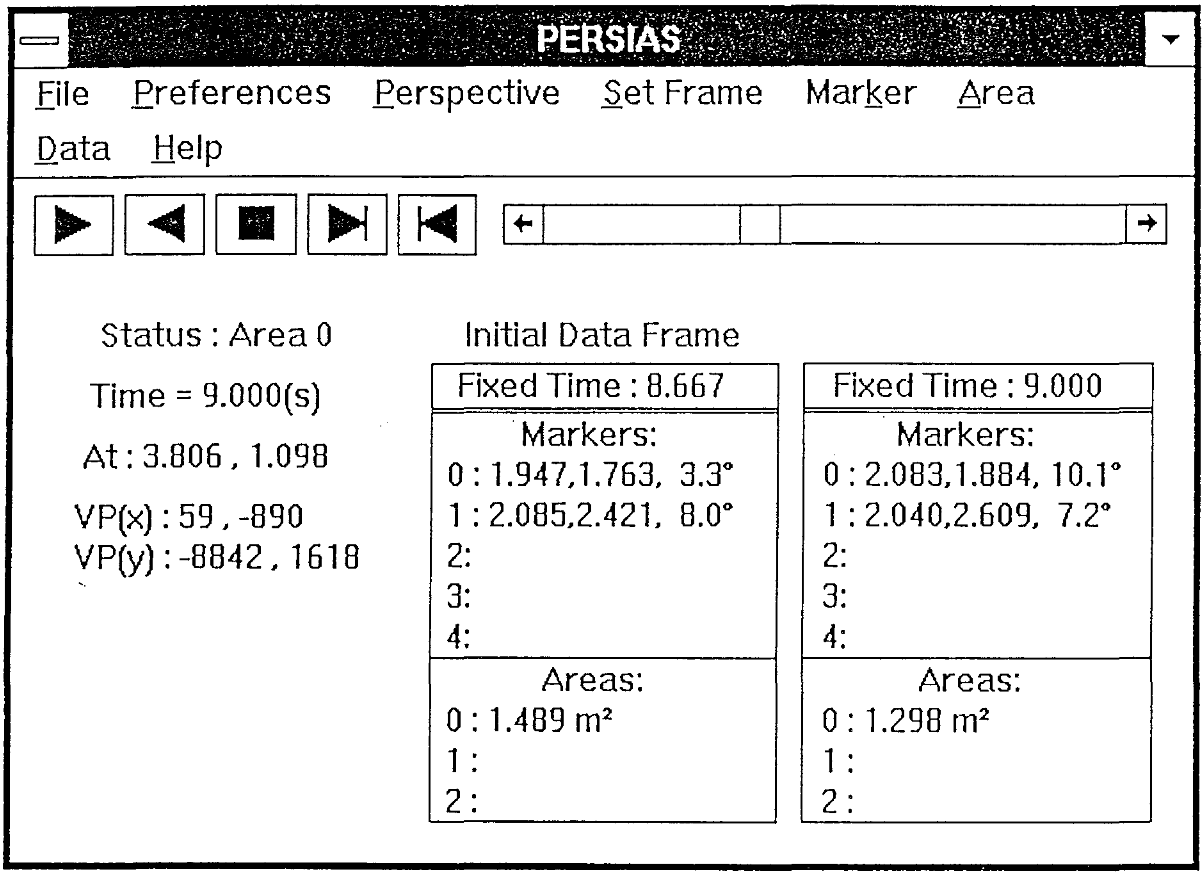


Figure 5.8. Persias Display

6 RESULTS AND DISCUSSION

6.1 General

The main result from these experiments is the movement velocities of individuals as a function of the interperson distance or the distance to the individuals in front. As well as the movement velocities the maximum flow rates were obtained. Another parameter that was also obtained in these experiments was the maximum turning rates or body twist of the individuals as they moved through the various building components tested. The first parameter obtained, the movement velocity, is an important parameter that is used to obtain a prediction of the amount of time that building occupants will spend in that particular building component. In the experiments performed the building components analysed were doorways, corridors and corners. The other parameter that was found, the maximum twisting rate is important as it will give us a prediction on how fast the individuals present in the building can turn to seek a new direction of travel. The turning rate is an important factor in the building components analysed, in the doorway experiment the occupants are required to turn towards the doorway if the route towards the door that they chose was not directly in line with it. In the corner experiment the turning is required to move around the corner and the speed of this turning is an important component. The other reason for turning could be to overtake a slower individual that may be blocking the route that was chosen. By turning a quicker direction of travel may be found especially if the occupant load is not that high. At the higher occupant loads the turning to overtake slower individuals is not as common due to the availability of free space for the overtaking individual to move into. There was not much passing observed in the doorway experiments. The passing that was observed consisted only of one occupant overtaking a slightly slower occupant. This was only observed when the densities were smaller and this passing involved an occupant who was on one side of the occupant who was being passed. This meant that there was no change in direction required by the occupant who was passing. There was no passing observed at higher densities as the occupants were seen to move as a crowd and the faster people in this crowd had no free space in front of them in which to move as they overtake. These observations were the same for the corner experiment with one exception which is overtaking was observed as people rounded the corner mainly due to the fact that the occupants on the inside of the corner had less distance to travel therefore moved around the corner faster. This however was only observed when the occupants were at high densities and did not involve a change of direction. At the lower densities the occupants all seemed to try and get close to the corner, thus minimising the distance they have to travel and no overtaking was observed.

Similar observation were made for the opposed flow experiments but even less overtaking was observed this was probably due to lines of people forming to let the approaching people through. It must be noted however that the occupants used in this experiment were all fit, young and healthy adults and therefore no individuals present who were considerably slower than the main population.

Another parameter that may be of interest is the speed reduction close to the walls. This could be due to a friction effect with the building occupants reducing their speed as they move close to the walls. While a velocity decrease was not observed in these experiments when the occupants came close to the walls, there was a tendency for the occupants to keep a distance away from the walls. This tendency was even observed at higher densities though at very high densities where there was no alternative the occupants were seen to come quite close to the walls but no speed reduction was observed. The walls that were constructed for these experiments were made of particle board and were quite smooth, the friction effect may be more evident if the wall in the areas tested had rough surfaces. Pauls, (Pauls, 1980) presented a solution that takes this effect into consideration. Pauls suggested that the width used in calculations should be an effective width. Observation in the experiment of movement through the doorway showed that while in the corridor there was a tendency for the occupants to keep this distance from the wall. When the occupants were forced together to get through the doorway the occupants were seen to squeeze through the door way touching the sides and even seen to turn sideways in order to get through the doorway. Therefore the effective width principle is not as relevant to doorways as it is for ordinary horizontal movement through a corridor.

The other aspect looked for during the doorway experiments was the arch effect. The arch effect as mentioned in section 3.3. is the effect where under high densities an arch is formed in front of the doorway due to pressure applied by the other occupants behind. This effect was not observed in the experiments conducted here. This may have been due to the fact that the critical density required for this to happen was not reached.

Observations made during the corner experiment showed us that the path the individuals tend to take while rounding a corner is the shortest possible path. If there is a low density of people the occupants tend to cut the corner as they move around it. When the densities become higher and the shortest path becomes hard to use as there are other occupants already using this space the people still tend to keep as close to the inside corner as possible. Watching the experiments that were conducted with a high density of people there was an area near the outside corner that was never used. This suggests that a more efficient corner would be a round corner this would both decrease the amount of area used and produce a more effective flow. This type of corner however would be impractical in most buildings.

6.2 Movement Velocities as a Function of Interperson Distance

6.2.1 Movement Velocity Through a Doorway

It is expected that the movement velocity of the occupants through a doorway would decrease as the distance between them decreases. That is the velocity decreases as the interperson distance decreases. This is the behaviour that has been reported by previous research for horizontal movement though they presented their results in the format with the occupants velocity decreasing as the density of the occupants increases. Most of the data from previous research suggest that the velocity of the occupants will be constant when the distance is greater than a particular distance and the velocity will rapidly decrease as the distance is decreased further. This can be seen in Figure 2.1 and Figure 2.4 where the velocity is relatively constant where the density is low. The constant velocity can be assumed to be the persons free unobstructed walking velocity then as the density increases or interperson distance is reduced there is a rapid decrease in velocity.

The data in this study correspond well to the data that has been presented earlier with a relatively constant velocity until the shorter interperson distances of less than 1.0m.

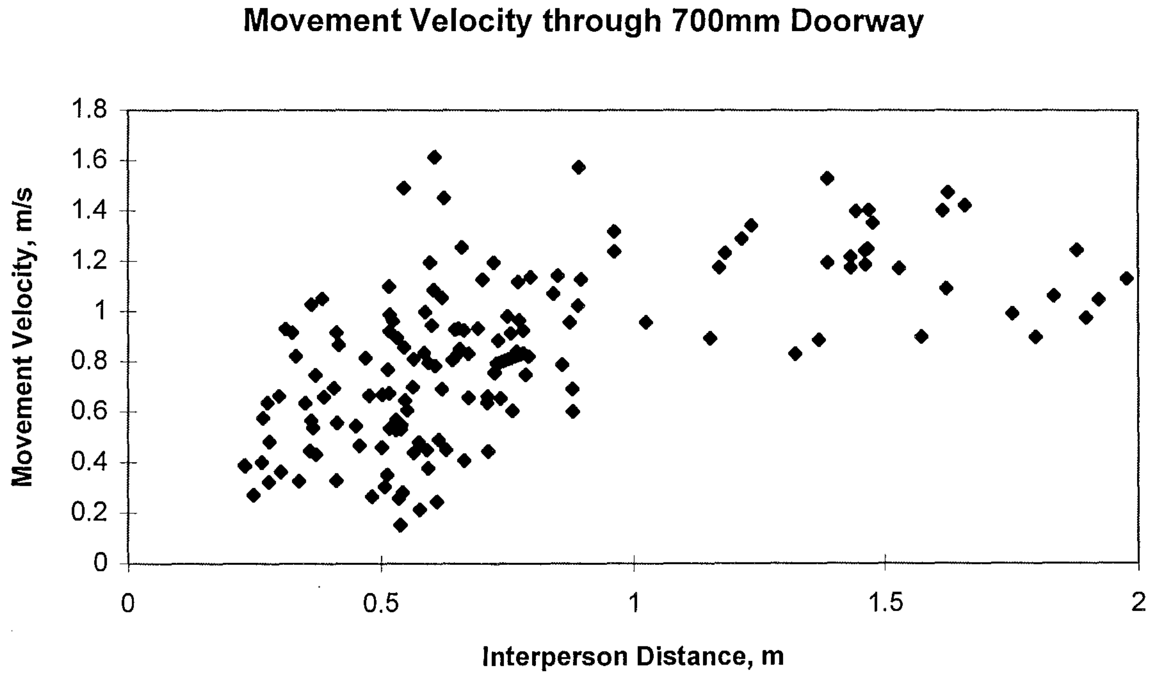


Figure 6.1. Movement Velocity through 700 mm doorway.

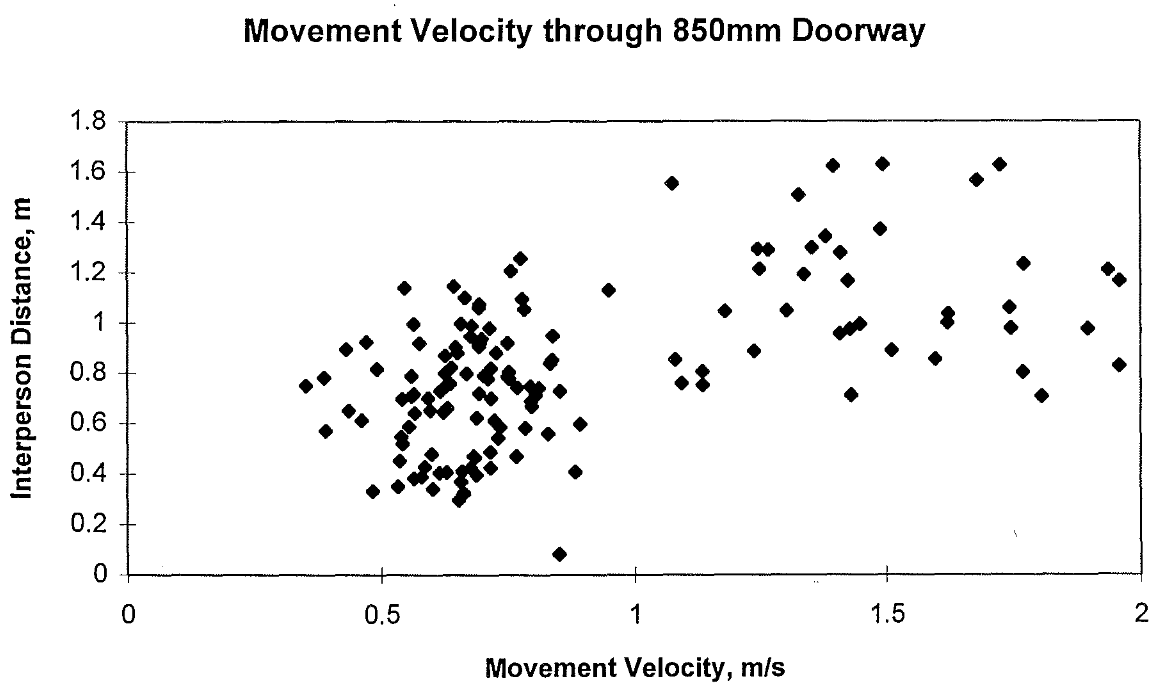


Figure 6.2. Movement Velocity through 850 mm doorway.

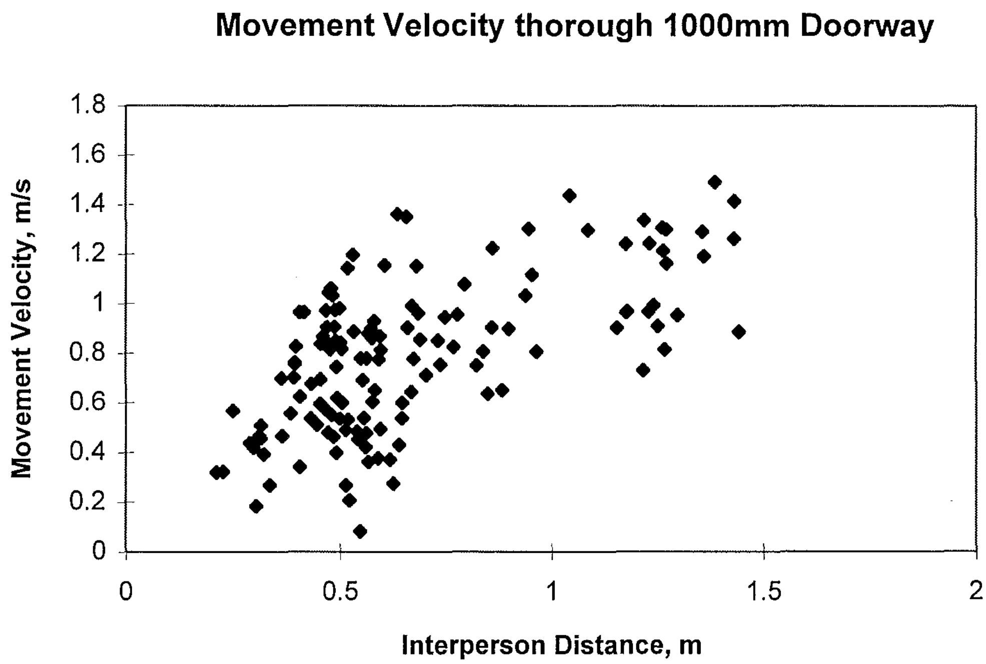


Figure 6.3. Movement Velocity through 1000 mm doorway.

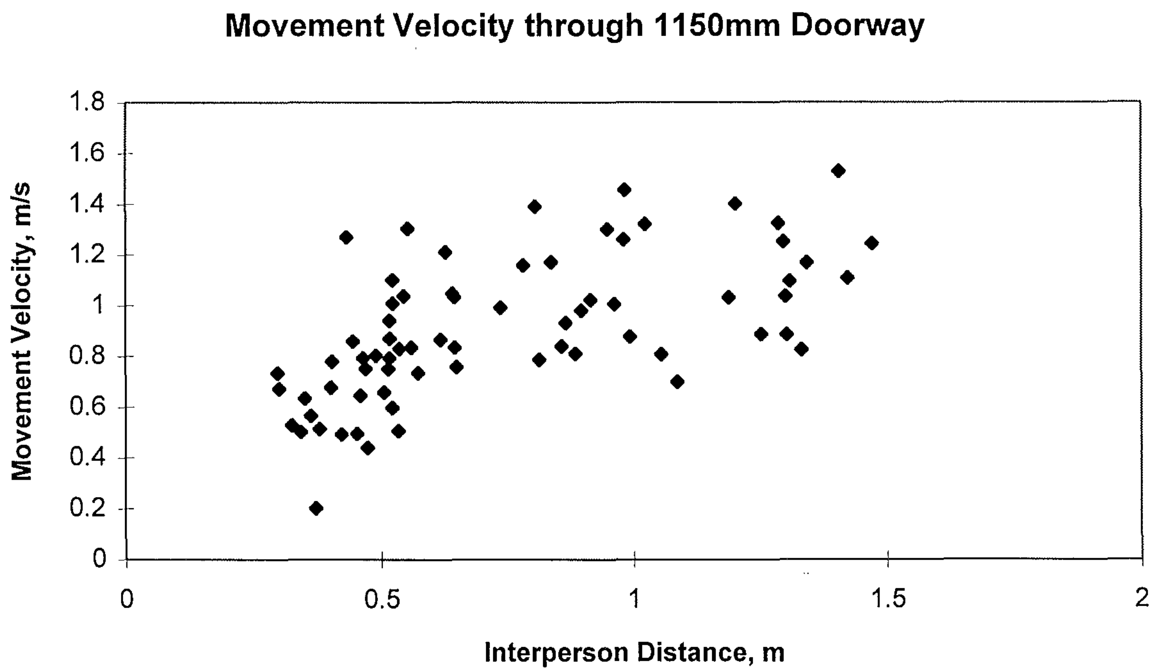


Figure 6.4. Movement Velocity through 1150 mm doorway.

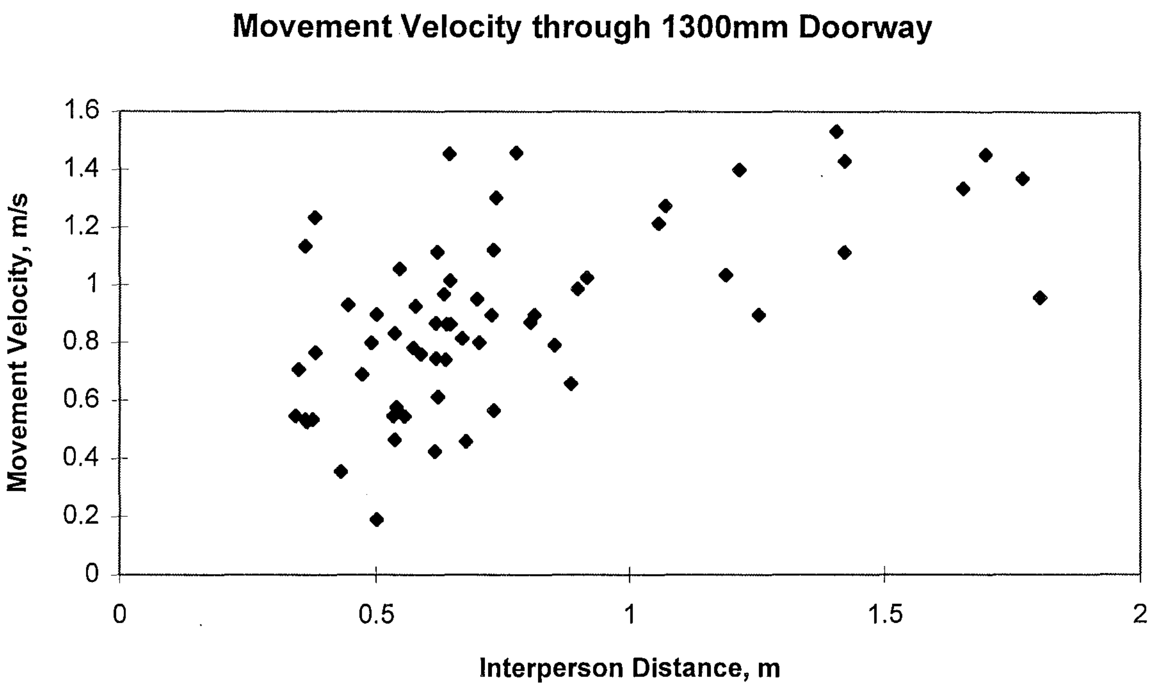


Figure 6.5. Movement Velocity through 1300 mm doorway.

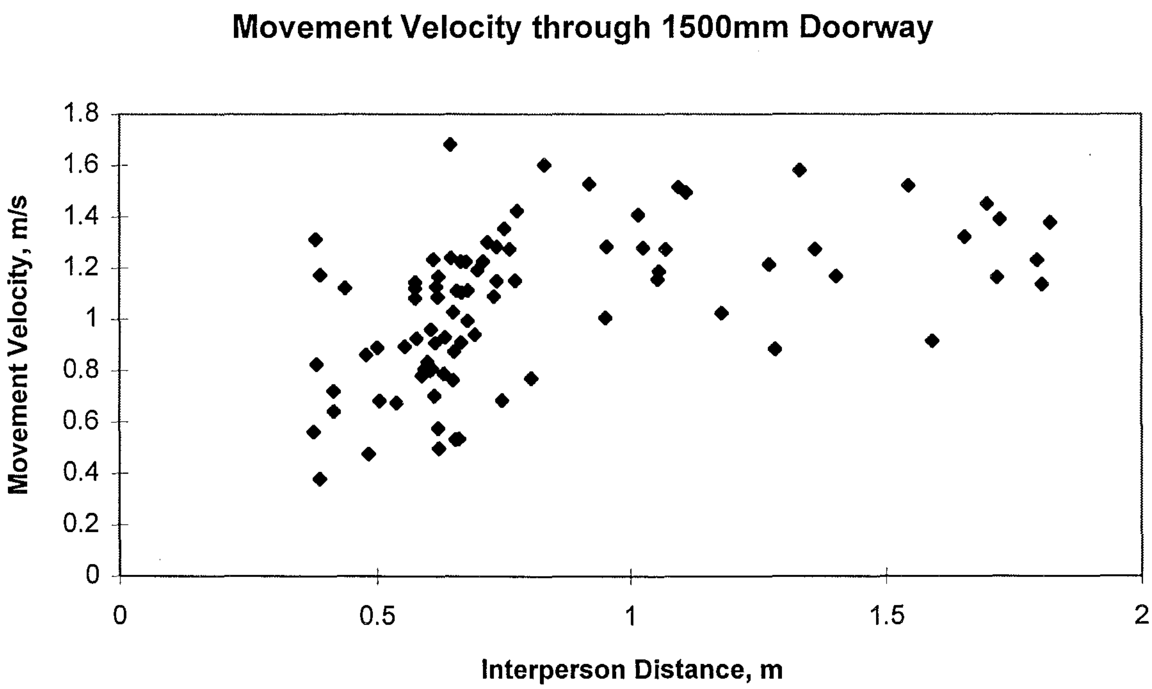


Figure 6.6. Movement Velocity through 1500 mm doorway.

All of the previous graphs contain a wide range of data points. A large range of data points can be expected when measuring the walking velocity of people. The large range can be expected due to the fact that each individual has different free walking velocities and body shapes. Even due to the large variation a clear trend can still be seen in all the previous graphs. Previous research also obtained large variations in walking velocities, For example Predtetschenski and Milinski (1969) data which related average speed to crowd density also had a large variation.

A trend can be seen in all the previous graph but a curve can not be determined easily due to the large variation in the data. An attempt has been made to fit a line of best fit to these graphs and five options were looked at. The five different lines can be seen in Figure 6.7. Note that all five of these lines have a velocity of zero at an interperson distance of 0.3m due to the assumed body dimensions of a person. The body ellipse 0.5m wide by 0.3m deep so when the interperson distance is 0.3m there is constant body contact. Interperson distances less than this can be assumed to be errors in distance calculations as this means the peoples bodies are overlapping. The error may be caused by different heights of people as the height is calculated as 1.5m (shoulder height). The values obtained in all of these experiments did not seem to be affected much by the change in the door size with similar free walking velocities found in each of the experiments and the velocities all decreasing rapidly at the shorter interperson distances of around 0.8m. Therefore the same curve or best fit line will be fitted to all the graphs. The equations for these five line are as follows:

For lines A, B, C and D the following formula has been used

$$v = V_u \times \sin\left[90 \times \left(\frac{d-b}{t_d - b}\right)\right] \quad \text{where } b \le d \le t_d \qquad (2)$$

$$v = V_u \quad \text{where } d > t_d \qquad (3)$$

Line E assumes a linear decrease in the movement velocity as the interperson distance is decreasing under 0.8m

$$v = \left(\frac{V_u}{t_d - b}\right)d - \left(\frac{V_u}{t_d - b}\right)b \quad \text{where } b \le d \le t_d \qquad (4)$$

$v = V_u$ where $d > t_d$ (5)

Where; v = impeded walking velocity (m/s)

V_u = free walking velocity (assumed to be 1.2m/s)

d = interperson distance

t_d = threshold distance (varied for each line)

b = body depth (0.3m)

Line A, $t_d = 0.7$m

Line B, $t_d = 0.8$m

Line C, $t_d = 0.9$m

Line D, $t_d = 1.0$m

Line E, $t_d = 0.8$m

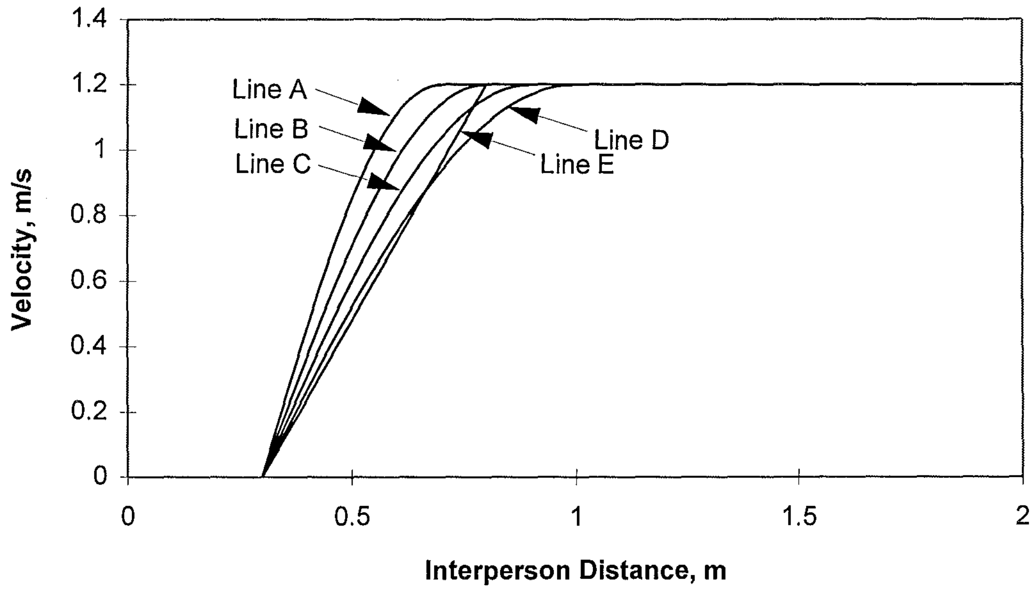


Figure 6.7. Suggested best fit lines to doorway experiment graphs

These five curves were then analysed to find the line which fit the data obtained the best, this was done by summing the squares of the differences between the actual data points obtained and the position on the best fit line. All of these lines could be considered reasonable as a line of best fit. There were different lines found as the best fit for different door sizes with line B fitting the data from the 1150 mm and the 1500 mm experiments, line C fitting the data best for 1000 mm and 1300 mm and Line D the best for 700 mm and 850 mm. However in all the cases where line C was not the best fit it was the second best fit line to the data. Also when summing the squares of all the data points from all the doorway experiments line C was found to be the best fit. Therefore line C is chosen as the best fit line for all the data. Line C has a threshold distance of 0.9m and a free walking velocity of 1.2 m/s, see equations (2) and (3). The raw data and best fit line calculations can be found in Appendix B.

6.2.2 Movement Velocity Around a Corner

The Data in this experiment also corresponds to earlier research showing that as the interperson distance decreases so does the velocity. A threshold distance can also be seen on the data obtained where the velocity is relatively constant. Above this Interperson distance the occupant can be assumed to be at their free walking velocities.

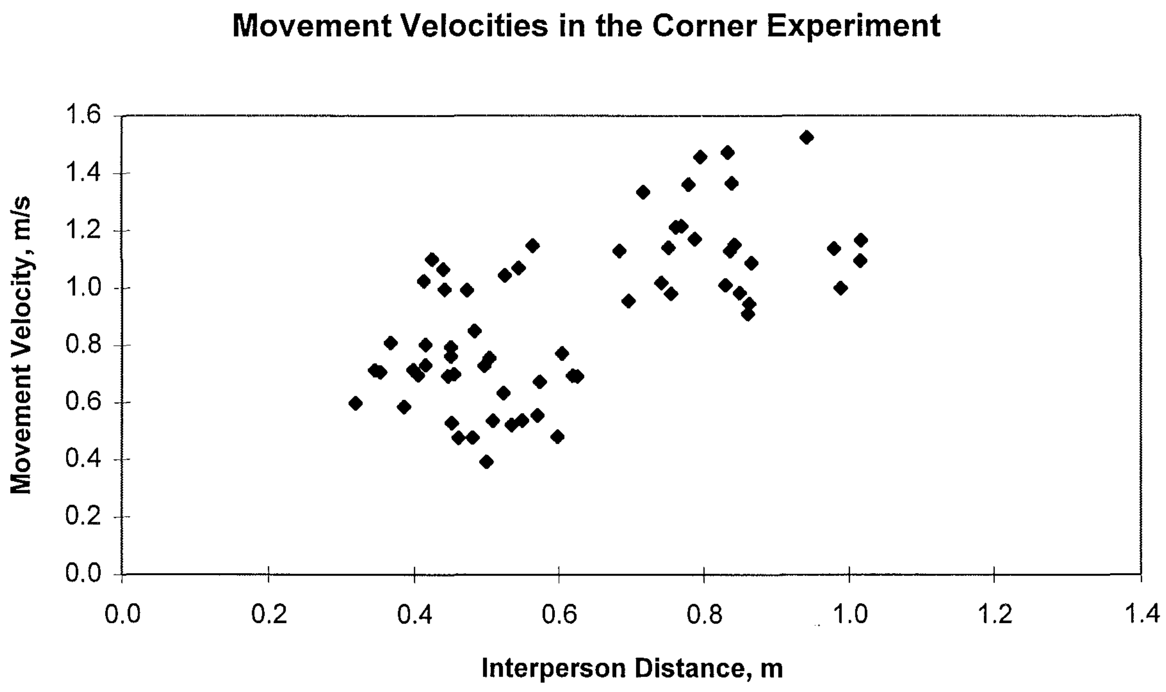


Figure 6.8. Movement Velocities Around a Corner.

The best fit lines that were used to fit the data obtained from the doorway experiments was also used to fit this graph of the corner experiment, see Figure 6.7. Any of these lines could be a good approximation of a best fit line but the best one was found by summing the squares of the differences By looking at the graph we can see that the average free walking velocity in this case is also around 1.2 m/s. There however seems to be a trend of slightly higher velocities at lower interperson distances which indicates that the decrease from this free walking velocity value starts at a lower interperson distance or the threshold distance is smaller. This was found to be the case when the analysis was performed and the best fit line was found to be line A.

The raw data and the analysis of the best fit line can be found in Appendix B.

During the corner experiments observation were made to see what happened to the velocity as the people were rounding the corner. There was very little change in velocity observed except from the occupants who were closest to the inside corner, with these occupants a slight decrease in velocity was observed as they turned but then the velocity returned to normal.

6.2.3 Movement Velocity (Opposed Flow)

The analysis of the movement velocity for opposed flow consisted of two parts. Looking both at the velocity of the minor flow, the one or more people opposing the main flow and also looking at how the major or main flow of people is affected. The effect of the opposing flow is mentioned in some previous research. Fruin mentions that in previous studies of two directional and multi directional flows there were only small variations from the curve he found for one way or unidirectional flows. Again as can be seen by the graphs obtained the occupants can be assumed to have a constant velocity when the interperson distance is larger than 1 m, below this value the velocity of the occupants decreases rapidly as the interperson distance decreases which corresponds to an increase in the occupants density. The constant velocity as before can be assumed to be the persons free walking velocity. Also note that there is a large scatter in the data which was also found in the previous experiments. This large scatter as mentioned before is expected when measuring the walking velocity of people due to the fact that all individuals have different free walking velocities.

A clear trend in the data can still be seen.

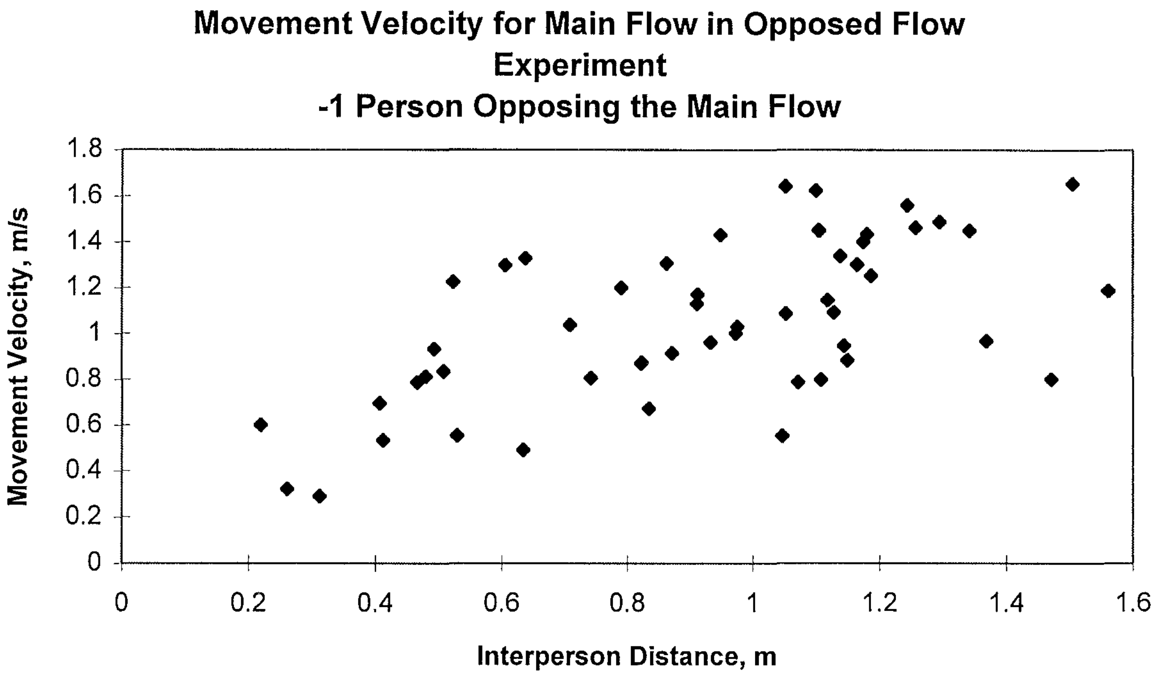


Figure 6.9. Movement Velocity for Main Flow in Opposed Flow Experiment

- 1 Person Opposing the Main Flow

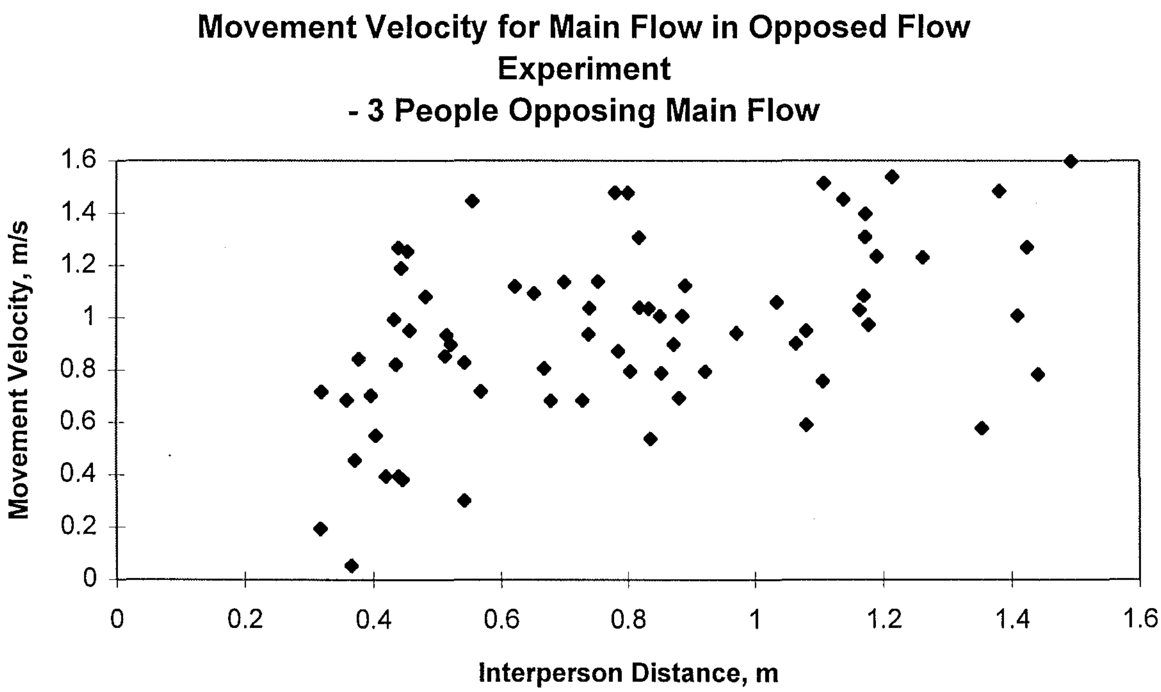


Figure 6.10. Movement Velocity for Main Flow in Opposed Flow Experiment

- 3 People Opposing the Main Flow

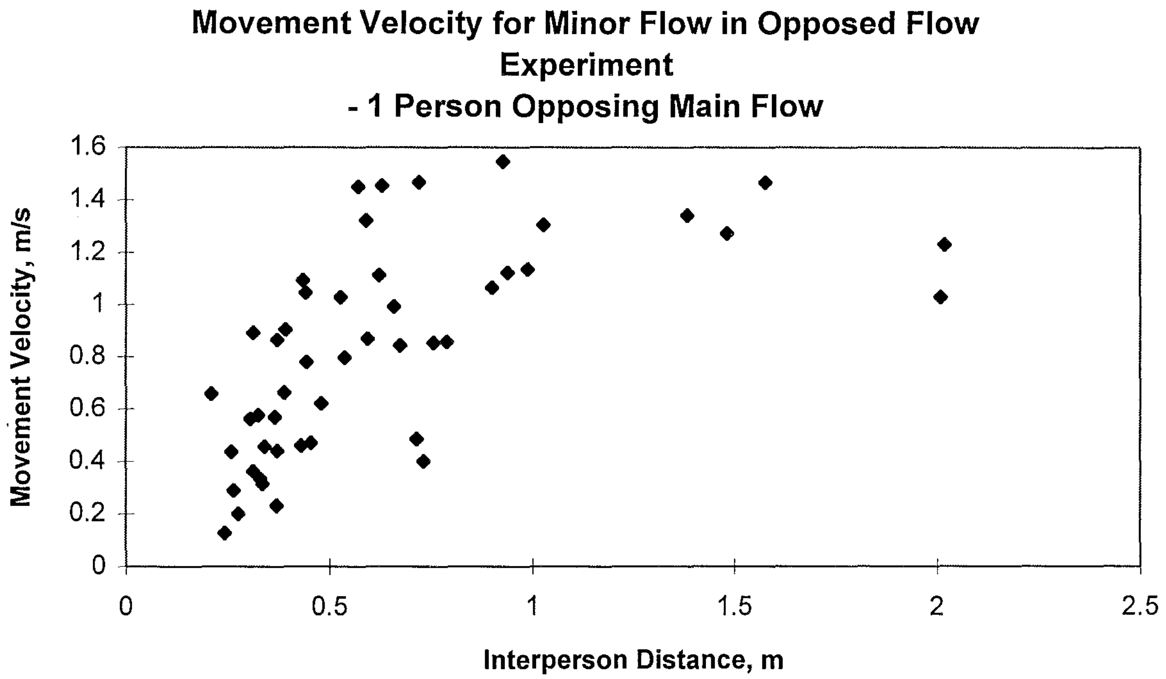


Figure 6.11 Movement Velocity for Minor Flow in Opposed Flow Experiment
- 1 Person Opposing the Main Flow

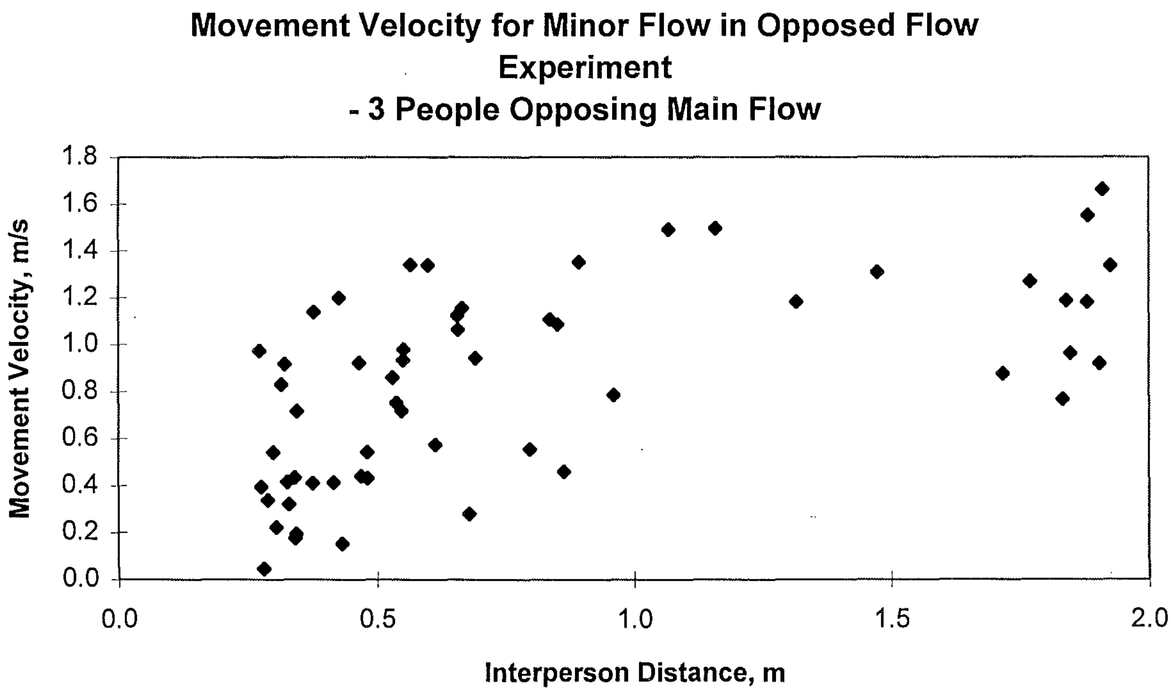


Figure 6.12. Movement Velocity for Minor Flow in Opposed Flow Experiment
- 3 People Opposing the Main Flow

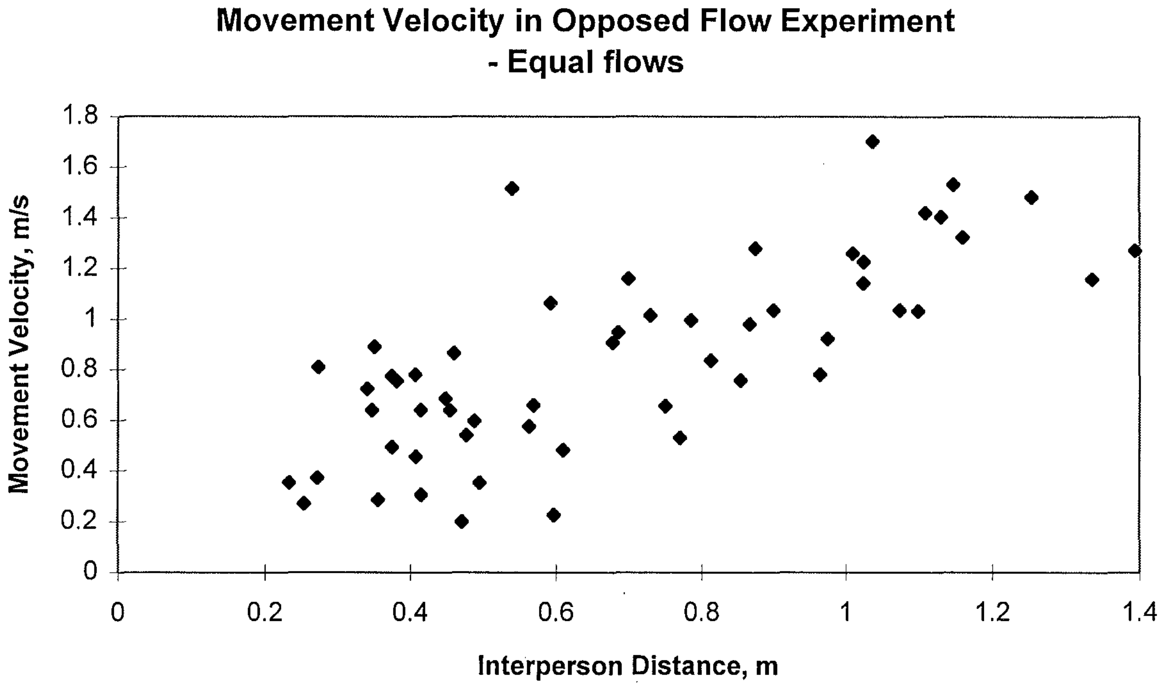


Figure 6.13. Movement Velocity in Opposed Flow Experiment
- Equal Flows

The best fit lines found for the doorway experiment can also be used to approximate a best fit line for these experiments, see Figure 6.7. The results obtained from this experiment when analysed showed that again the free walking velocity had an average of around 1.2 m/s. This free walking velocity remained constant until a threshold distance was reached. Once this threshold distance was reached the movement velocity decreased rapidly as the interperson distance decreased. For the analysis of the main flow of occupants in the two experiments where there were one or three people opposing the main flow, the best fit line was found to be line A. This best fit line was also found to be the best fit line for the minor flow in these two experiments. This line is steeper and has a lower threshold distance than the line that was found to be the best fit for the doorway experiments. The line found as the best fit line for the experiment where the opposing flow was equal in size was line C which was the same as the best fit line found for the doorway experiments. The best fit line found for all the data in the opposed flow experiments was line A. Line A was found as the best fit line for both the opposed flow and the corner experiments thus agreeing with previous research [Fruin, 1971] which states that the velocities as a function of density and the flows are not greatly affected by having an opposing flow. This experiment however was carried out in a wide corridor that had been constructed. If this opposed flow was through a narrow door or similar restriction then the flows and velocities may be affected more.

6.2.4 Movement Velocity (General)

An overall best fit line was also calculated using the data obtained from all the experiments that were performed. Using the same method as in each experiment summing the squares of the differences between the actual velocity and the best fit line velocity an overall best fit line was found. The overall best fit line was line C which was the best fit line found in the doorway experiments and the opposed flow experiment that had equal flows in each direction. This line was also close to all the best fit lines chosen for the other experiments. A table of all the analysis of the best fit lines can be found in Appendix B.
The uncertainty associated with these experiments is quite high due to the fact that all individuals have a different free walking velocity. By looking at the scatter on the graphs obtained, the uncertainty seems to be greater at the lower interperson distances. To check this the standard deviation from the best fit line at intervals of 0.1m has been calculated for each of the experiments. See Figures 6.14.,6.15. and 6.16.

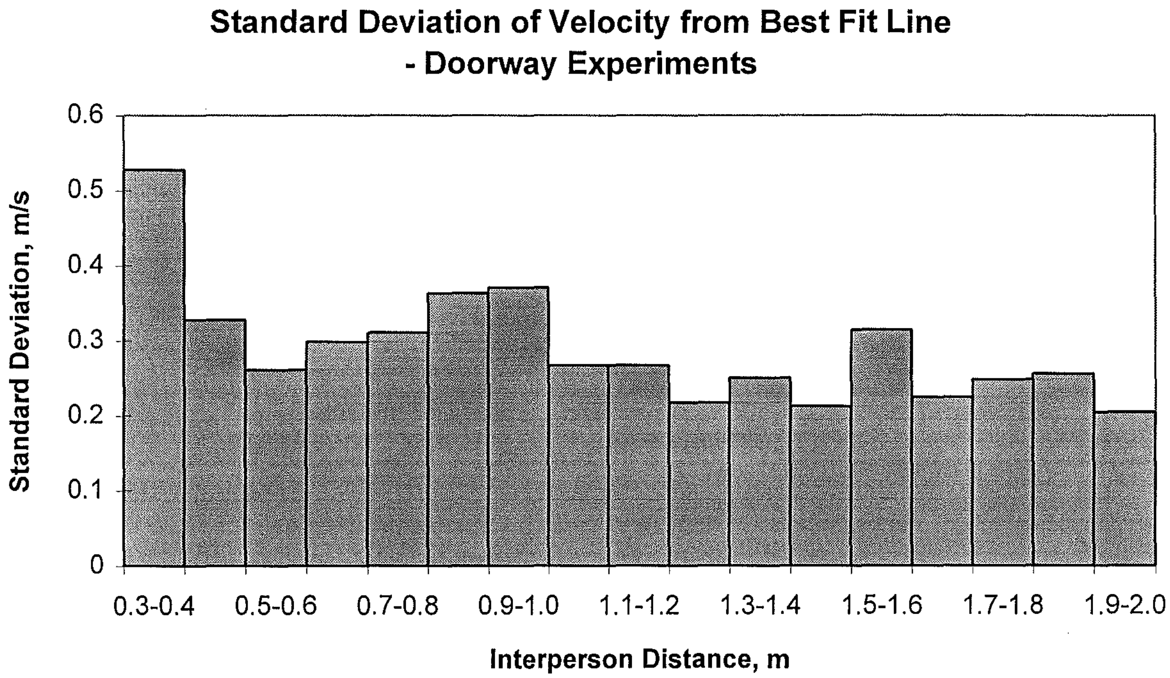


Figure 6.14. Standard Deviation of Velocity from Best Fit Line.

- Doorway Experiments

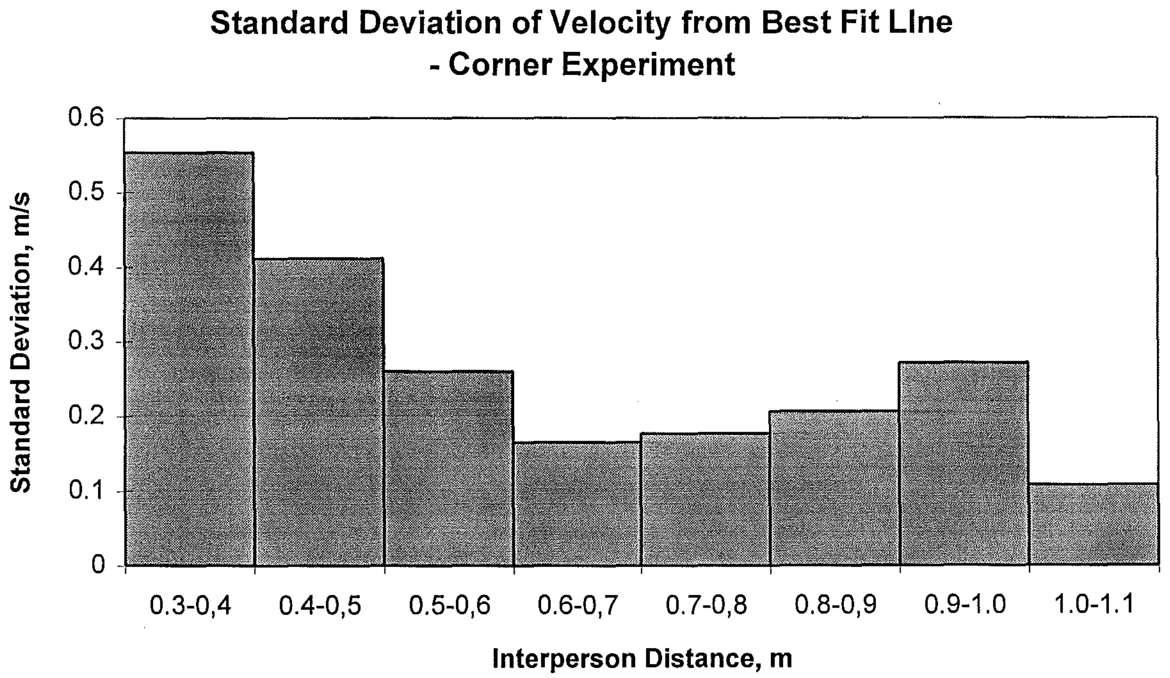


Figure 6.15. Standard Deviation of Velocity from Best Fit Line

- Corner Experiment

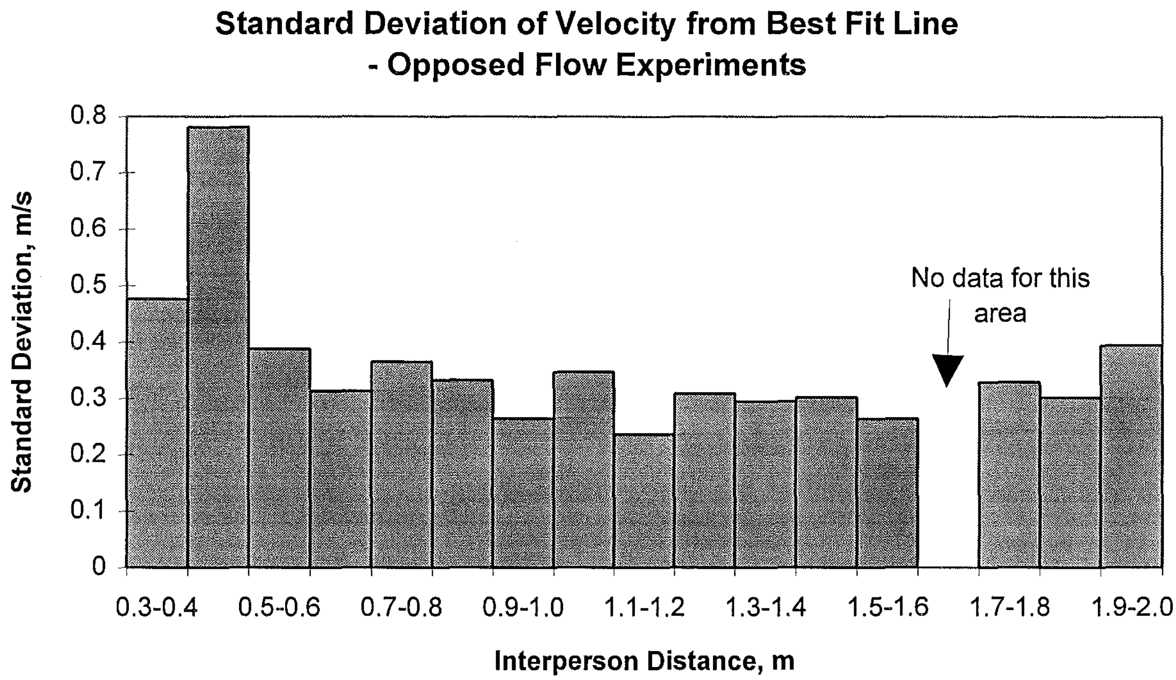


Figure 6.16. Standard Deviation of Velocity from Best Fit Line
- Opposed Flow Experiments

From the previous 3 graphs we can see that the uncertainty is greater in the lower interperson distances. This may be due to the fact that the velocities are more affected by the distance between the individuals where the interperson distance is lower.The effect the smaller interperson distances has would also vary between individuals. The highest standard deviations are seen at the very low interperson distances from 0.3 to 0.5 metres. These distances are where the movement velocity is assumed to be very low and approaching zero but there were a few cases where the velocities obtained at these distances were still quite high thus contributing to the large uncertainty.

6.3 Flow Rates

The maximum flow rate for each of the experiments was also determined. To find the flow rate the number of people passing through the doorway over a specific time period was counted. The flow was not counted from the first person to pass a given point but was started after about a third of the test subjects had passed. This was done to ensure a steady state flow had formed. The flow rates obtained in these experiments are higher than the design values given in the previous research mentioned in section 3. The higher flow rates could be due to the fact that the test subject all knew each other and were therefore less concerned with their personal space, which in other cases when invaded could cause the occupants to slow down.

6.3.1 Movement Through a Doorway

The maximum flow rate was found for each of the experimental door widths by finding the flow rate of each experiment with the different densities. The maximum flow rate for each of the door widths were recorded and are shown in the graph below. From the graph we can see that the flow rates obtained as a function of the various door widths is approximately linear. The equation of the best fit line obtained for these flows is

$Q = 0.0026 \times w - 0.59$

where Q = flow rate (persons/second)

w = door width (mm)

Door width, mm	Maximum Flow Rate, Persons/second
700	1.31
850	1.42
1000	2.23
1150	2.34
1300	2.67
1500	3.39

Table 6.1 Maximum flow rates obtained for each door width.

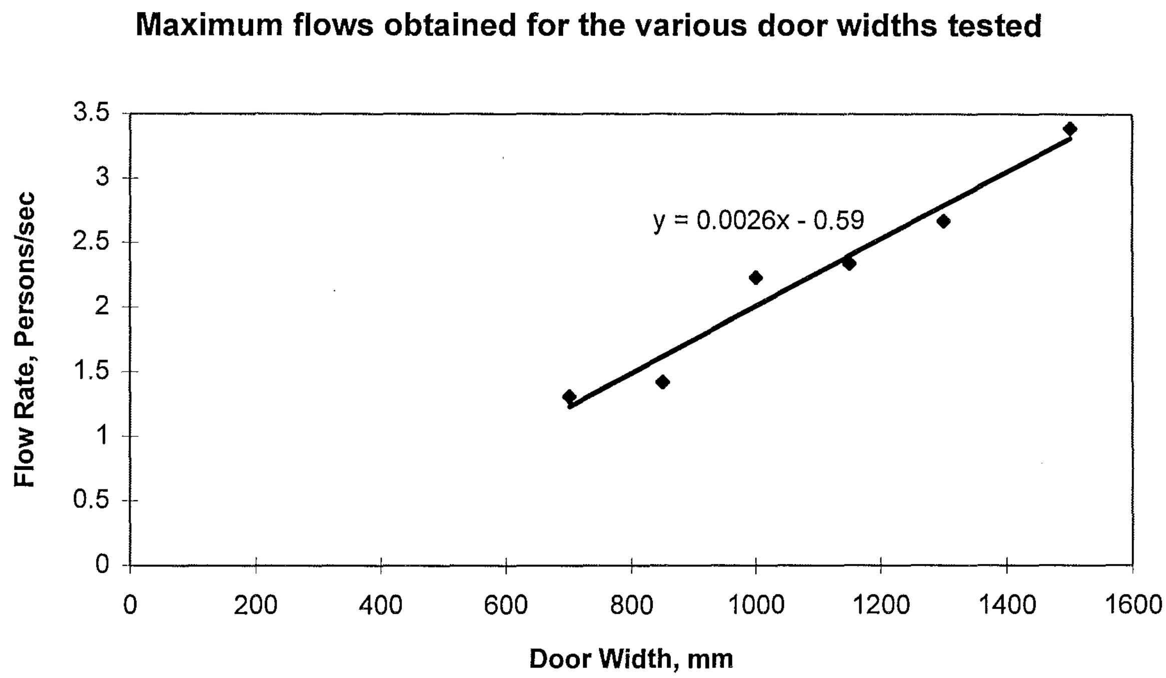


Figure 6.17. Maximum flow rates obtained for each door width.

6.3.2 Movement Around a Corner

The maximum flow rate has also been found for the corner experiment. The maximum flow rate found was 4 people/second. This flow rate is for the whole corridor width and is not given as a flow rate per metre width. To find this flow rate the number of people passing a given point over a set amount of time was recorded for each of the experiments conducted. Each of the experiments consisted of a different density of occupants therefore the flow rates found in each varied considerably.

6.3.3 Opposed Flow

The flow rates for the opposed flow experiments have also been found. The flow rates obtained here is a total flow rate in the corridor which is 2m wide. The total number of people passing a specified point in either direction in a set time was counted for each experiment conducted. Thus the flow rates for each density tested in each of the 3 cases was found but only the maximum has been recorded.

Opposed Flow Experiments	Maximum Flow Rate, Persons/second
1 Person Opposing Main Flow	3.4
3 People Opposing Main Flow	3.9
Equal Flows in Both Directions	3.6

Table 6.2 Maximum flow rates obtained in opposed flow experiments.

These flow rates found are slightly higher per unit width than the flow rates obtained during the doorway experiments. This may be due to the fact that the edge effect is more noticeable in movement in a corridor than it was through a doorway. By reducing the corridors width to an effective width the flow rates obtained would be very similar.

6.3.4 Flow Rates Found in Previous Research

The flow rates found above seem to be larger than the flow rates that have been found in previous research.

The maximum design flow that was found in the previous research that was mentioned in section 3.

Source	Average Maximum Flow (persons/metre/second)	Ultimate Flow Capacity
Fruin (unidirectional)	1.43	4.37
Fruin (opposed flow)	1.35	
Predtetschenski & Milinski	1.7	2.06
Hankin & Wright	1.48	1.92

Table 6.3. Maximum Flow Rates from Previous Research

Though the values of the average maximum flow seem to be lower than the ones obtained in the above experiments. With the exception of Fruins value, the values obtained for the ultimate flow capacity very similar to the values that were obtained. A reason that the flows that were obtained in these experiments were higher than the average maximum flow rate could be the fact that all the test subjects knew each other and were therefore not as concerned about their personal space. The lowest maximum flow rate that was obtained in the experiments was 1.67 persons/metre/second and the largest was 2.26 persons/metre/second. The values of the flow rates obtained in these experiments should not be used for design until more experiments have been done in a real life situation where the occupant both do not know each other and are not completely familiar with their surroundings.

6.4 Maximum Turning Rates Obtained in Experiments

The other main objective of these experiments as well as finding the movement velocity of the evacuating people was to find the maximum rate of turning or 'body twist' in each of the experiments performed.

6.4.1 Movement Through a Doorway

The results for the doorway experiments were as expected, with higher rates of body twist in the experiments with the smaller door sizes. This is due to the fact that when the doorway was small the people present had to both alter their course to move through the doorway. Also as the doorways size was reduced the occupants started to form queues thus producing more obstructions for the occupants and producing more cases where the occupants are required to change direction. The maximum rate of body twist that was observed in these experiments was 168°/second in the experiment where the door size was 850 mm. The average of the six maximum values found in each experiment is 124°/second (this is higher than the value that is currently used by Simulex which is a more conservative value of 100°/second.) As the computer model is to be used for design using the value of 100°/second produces a more conservative safe design and will simulate the average maximum rate of turning rather than the maximum that was recorded by one individual who may be considered as above average.

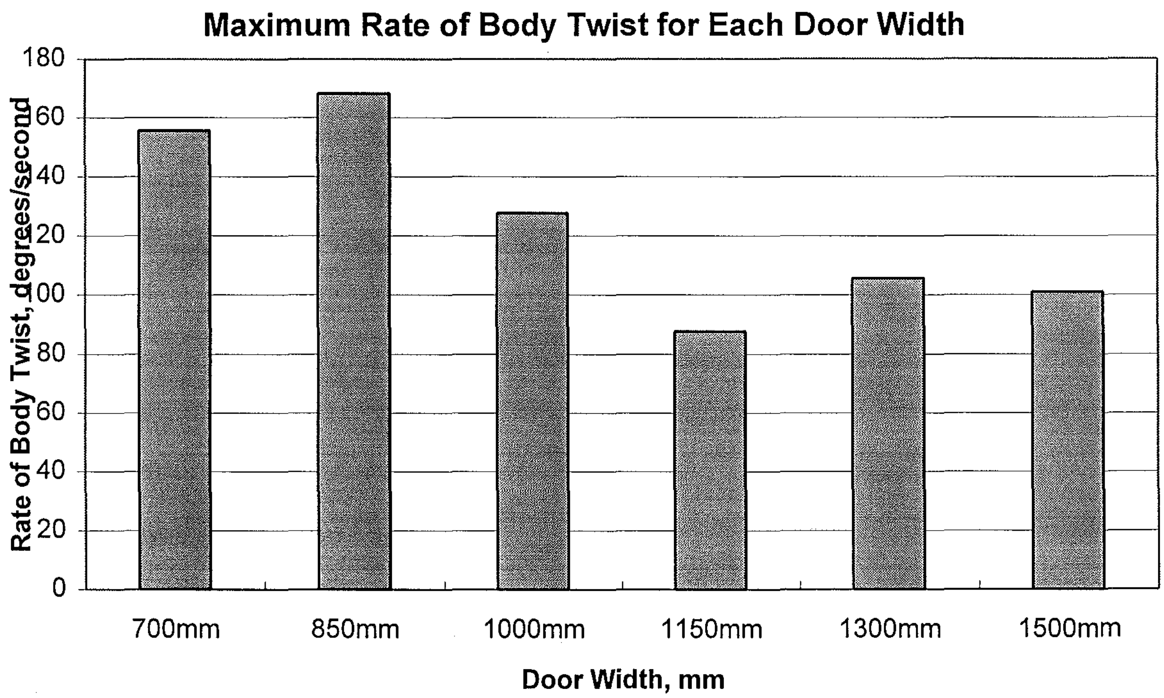


Figure 6.18. Maximum rate of Body Twist found for each door width

6.4.2 Movement Around a Corner

The maximum rate of body twist found for the corner experiment was 143°/second. This value was an extreme value compared to the other values that were obtained as the rest were under 120°/second. When comparing this result to that obtained in the other two experiments the values obtained were much lower this may be due to the fact that turning was only necessary while rounding the corner and this turning was more gradual than what is required when turning to pass through a narrow doorway or when turning so as to get passed a person travelling in the opposite direction. The only turning observed in this experiment was while the occupants were rounding the corner and while doing this they were still moving forward. The maximum value obtained is still higher than the value that is used in Simulex which is 100°/second and can be considered a more conservative value to be used in design.

6.4.3 Opposed Flow

The maximum rate of turning or 'body twist' was also found for the opposed flow experiments The results were as expected with the two minor flows having both higher rates of body twist and also the body twist was more evident as the opposing person or people turned to make their way through the oncoming main flow. The main flow also had some high values of the maximum rate of body twist this would most probably be from the leading people of the group as the minor flow approached them. The experiment conducted that consisted of equal and opposite flows had the smallest maximum rate of body twist and once the flows had formed lines there was not much turning observed as the occupants only had to walk in the forward direction.

The maximum flows found in these experiments was 208°/second for the minor flow with one person opposing and 184°/second for the minor flow with three people opposing. Though these values are much greater than the value that is currently being used by Simulex these two values are extreme with most of the remaining values below 160°/second. The value of 100°/second still seems to be a reasonable value for the average rate of body twist.

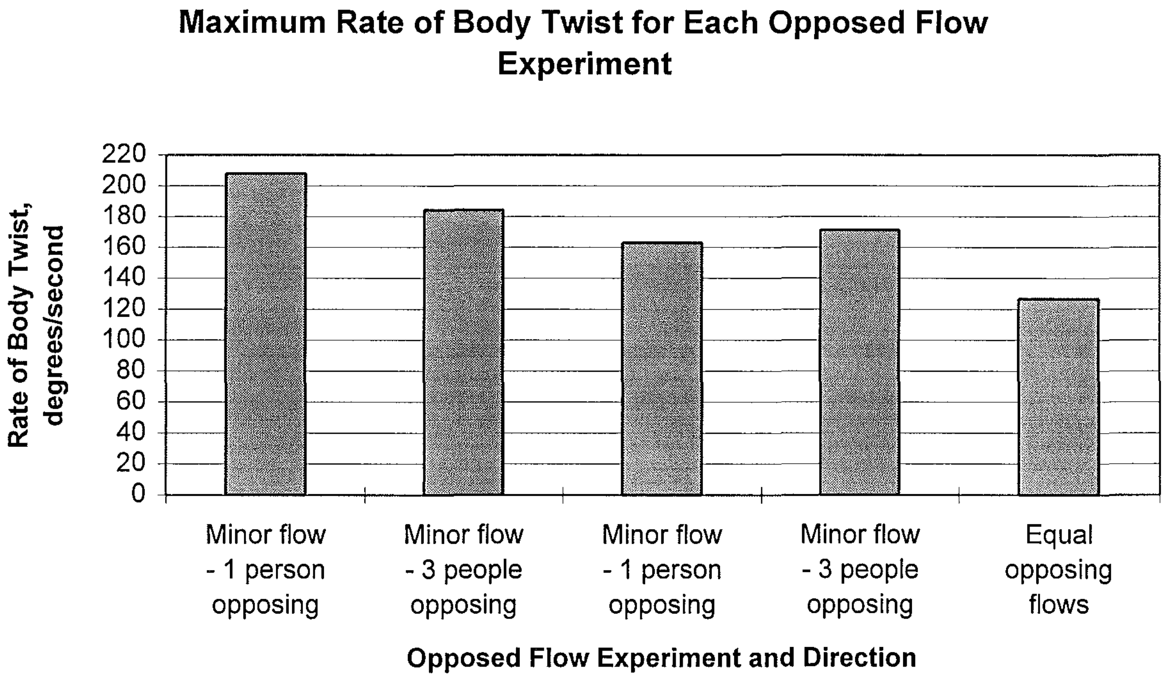


Figure 6.19. Maximum Rate of Body Twist for Each Opposed Flow Experiment.

7 Future Studies

All the results and conclusions in this report come from the analysis of evacuation experiments conducted by the author in a laboratory. This enabled the experiments to be conducted easily . Future studies could include doing the same or similar experiments in a real life situation thus reducing the bias that may of been present by performing the experiments in a laboratory situation. By doing the experiments in a real life situation the test subjects do not have to know that they are being filmed therefore will act as they normally would, this was impossible to do in the experiments that have been conducted in this report also there is more likelihood that the people involved will not know each other especially if the area used is somewhere like a train station where many of the people present are commuting to work. Using a real life situation will also get data that represents the whole population better as in the experiments conducted here the test subjects were all between 20 and 30 years old. Another situation that would be good to study is the presence of disabled persons and how this effects both their movement and the movement of able bodied people. Doing this would also provide data on the individual movement of disabled individuals who may be in wheelchairs, on crutches or using other types of walking aids.

8 REFERENCES

1 Buchanan A. H., Fire Engineering for a Performance Based Code. Fire Safety Journal Vol. 23, pp 1-16, 1994.

2 Drager K. H., Lovås G., Wilkund J., Soma H., Evacsim - A Comprehensive Evacuation Simulation Tool. A/S Quasar Consultants, Oslo, Norway, 1992.

3 Fahy R. F., Exit89 - An Evacuation Model for High-Rise Buildings - Recent Enhancements and Example Applications. International Conference on Fire Research and Engineering, September 10-15, 1995. Orlando, FL., Society of Fire Protection Engineers, Boston, MA, 1995.

4 Fahy R. F., 1991. Exit89: An Evacuation Model for High-Rise Buildings. Fire Safety Science - Proceedings of the Third International Symposium, pp. 815-823, University of Edinburgh, July 8-12, Elsevier Science Publishers, London.

5 Fast Electronic GmbH, Movie Machine Pro Manual. München, February 1994.

6 Fast Multimedia AG, M-JPEG Option Manual. München, February 1995.

7 Frantzich H., Study of movement on stairs during evacuation using video analysing techniques. LUTVDG/TVBB--3079--SE. Department of Fire Safety Engineering. Lund University, Lund 1996.

8 Fruin J., Pedestrian Planning and Design. Metropolitan association of urban designers and environmental planners inc. New York 1971.

9 Galea E. R., Perez Galparsoro J. M., A computer-based simulation model for the prediction of evacuation from mass-transport vehicles. Fire Safety Journal Vol. 22 No. 4 pp 341-366, 1994.

10 Hankin B. D., Wright R. A., Passenger Flows in Subways, Operations Research Quarterly, Vol. 9 pp 81-88, 1958.

11 Kisko T. M., Francis R. L., Evacnet+: A computer program to determine optimal building evacuation plans

12 Kisko T. M., Francis R. L., Network Models of Building Evacuation: Development of Software System. Department of Industrial and Systems Engineering. University of Florida, Gainesville 1984.

13 Kisko T. M., Francis R. L., Noble C. R., Evacnet+ Users Guide. Department of Industrial and Systems Engineering. University of Florida, Gainesville 1984.

14 Levin B. M., Exitt - A Simulation Model of Occupant Decisions and Actions in Residential Fires: Users Guide and Program Description. U.S. Department of Commerce, NBS, Center for Fire Research, Gaithersburg 1987.

15 Melinek S. J., Booth S., An analysis of evacuation times and movement of crowds in buildings. BRE Current paper CP 96/75 FRS. Borehamwood 1975.

16 Nelson H. E., MacLennan H. A., Emergency movement. SFPE Handbook of Fire Protection Engineering. NFPA Quincy MA, USA 1988

17 New Zealand Building Code Handbook and Approved Documents. Building Industry Authority, Wellington, New Zealand 1992.

18 Pauls J., Effective-width model for evacuation flow in buildings. SFPE engineering application workshop pp 215-232. Boston 1980.

19 Persson H., Evaluation of Exit89 - An Evacuation Model, Department of Fire Safety Engineering, Lund University, Lund 1996.

20 Peschl, I.A.S.Z., Doorstromingscapaciteit van deuropeningen bij panieksituaties. BOUW nr. 2 9-1.1971, pp 62-67, 1971.

21 Predtetschenski V. M., Milinski A. I., Personenströme in gebäuden - Berechnungmethoden fur dei projektierung. Staatsverlag der Deutschen Demokratischen Republik. Berlin 1971.

22 The Building Act 1991, The Building Regulations 1992. New Zealand Government, Wellington, New Zealand.

23 Thompson P. A., Developing new techniques for modelling crowd movement. University of Edinburgh 1994.

24 Thompson P. A., Persias Software Help file, Help version 3.10.425, 1995.

25 Thompson P. A., Modelling Evacuation with Simulex - On-line Help. University of Edinburgh, 1996.

9 BIBLIOGRAPHY

1 Maclennan H. A., Towards an Integrated Egress/Evacuation Model Using an Open Systems Approach. Fire Safety Science - Proceedings of the First International Symposium, pp 581 - 590, USA October 7 - 11 1985, Hemisphere Publishing Corporation, Washington 1985.

2 Purser D. A., Interactions Between Behaviour Patterns and Physiological Impairment in Escape from Fire. Interflam 93 Conference, Oxford UK 30th March - 1st April 1993, Fire Research Station, UK 1993.

3 Passini R., Spatial Representation, A Wayfinding Perspective, Journal of Environmental Psychology (1984) 4, pp 153 - 164, Academic Press Inc., London 1984.

4 Horiuchi S., An Overview of Research on "People-Fire Interactions". Fire Safety Science - Proceedings of the Second International Symposium, pp. 501 - 510,

5 Sime J. D., Movement Toward the Familiar - Person and Place Affiliation in a Fire Entrapment Setting. Environment and Behaviour, Vol. 17 No. 6, November 1985 pp. 697 - 724, Sage Publications 1985.

6 Proulx G., The Time Delay to Start Evacuating Upon Hearing a Fire Alarm. 38th Annual Meeting of the Human Factors and Ergonomics Society, Nashville, Tennessee, October 24 - 28, 1994.

7 Stahl F. I., Archea J., An Assessment of the Technical Literature on Emergency Egress from Buildings. U.S. Department of Commerce, NBS, Center for Building Technology, Washington, 1977.

8 Williams W., Hopkinson J. S., The behaviour of people in fires. Building Research Establishment, Information Paper, IP 20/85, Building Research Station, Garston, Watford, 1985.

9 Webber G. M. B., Hallman P. J., Emergency lighting and movement through corridors and stairways. Department of the Environment, Building Research Establishment, Garston, Watford, 1987.

Appendix A

Clause C1-OUTBREAK OF FIRE
OBJECTIVE
C1.1 The objective of this provision is to safeguard people from injury or illness caused by fire
FUNCTIONAL REQUIREMENT
C1.2 In buildings fixed appliances using the controlled combustion of solid, liquid or gaseous fuel, shall be installed in a way that reduces the likelihood of fire.
PERFORMANCE
C1.3.1 Fixed appliances shall be installed so as to avoid the accumulation of gases within the installation an in building spaces, where heat or ignition could cause uncontrolled combustion or explosion.
C1.3.2 Fixed appliances shall be installed in a manner that does not raise the temperature of any building element by heat transfer or concentration to a level that would adversely affect its physical or mechanical properties or function.

Clause C2- MEANS OF ESCAPE
OBJECTIVE
C2.1 The objective of this provision is to:
(a) Safeguard people from injury or illness from a fire while escaping to a safe place, and
(b) Facilitate fire rescue operations.

FUNCTIONAL REQUIREMENT
C2.2 Building shall be provided with escape routes which:
(a)Give people adequate time to reach a safe place without being overcome by the effect of fire, and
(b)Give fire service personnel adequate time to undertake rescue operations.

PERFORMANCE
C2.3.1 The number of open paths available to each person escaping to an exitway or final exit shall be appropriate to:
(a) The travel distance.
(b) The number of occupants,
(c) The fire hazard, and
(d) The fire safety systems installed in the firecell.

C2.3.2 The number of exitways or final exits available to each person shall be appropriate to:
(a) The open path travel distance,
(b) The building height,
(c) The number of occupants,
(d) The fire hazard, and
(e) The fire safety systems installed in the firecell

C2.3.3 Escape routes shall be:
(a) Of adequate size for the number of occupants,
(b) Free of obstruction in the direction of escape,
(c) Of length appropriate to the mobility of the people using them,
(d) Resistant the spread of fire as required by Clause C3 "Spread of Fire",
(e) Easy to find as required by Clause F8 "Signs"
(f) Provided with adequate illumination as required by Clause F6 "Lighting for Emergency", and
(g) Easy and safe to use as required by Clause D1.3.3 "Access Routes".

Clause C3- SPREAD OF FIRE
OBJECTIVE
C3.1 The objective of this provision is to:
(a) Safeguard people from injury or illness when evacuating a building during fire.
(b) Provide protection to fire service personnel during fire fighting operations.

(c) Protect adjacent household units and other property from the effects of fire
(d) Safeguard the environment from adverse effects of fire.

FUNCTIONAL REQUIREMENT
C3.2 Buildings shall be provided with safeguards against fire spread so that:
(a) Occupants have time to escape to a safe place without being overcome by the effects of fire,
(b) Fire-fighters may undertake rescue operations and protect property,
(c) Adjacent household units and other property are protected from damage, and
(d) Significant quantities of hazardous substances are not released into the environment during fire.

PERFORMANCE
C3.3.1 Interior surface finishes on walls, floors ceilings and suspended building elements, shall resist the spread of fire and limit the generation of toxic gases, smoke and heat, to a degree appropriate to:
(a) The travel distance,
(b) The number of occupants,
(c) The fire hazard, and
(d) The active fire safety systems installed in the building.

C3.3.2 Fire separations shall be provided within the buildings to avoid the spread of fire and smoke to:
(a) Other firecells
(b) Spaces intended for sleeping, and
(c) Household units within the same building or adjacent buildings.

C3.3.3 Fire separations shall:
(a) Where openings occur, be provided with fire resisting closures to maintain integrity of the fire separations for an adequate time, and
(b) Where penetrations occur, maintain the fire resistance ratings of the fire separation.

C3.3.4 Concealed spaces and cavities within buildings shall be sealed and subdivided where necessary to inhibit the unseen spread of fire and smoke.
C3.3.5 External walls and roofs shall have resistance to the spread of fire, appropriate to the fire load within the building and to the proximity of other household units and other property.
C3.3.6 Automatic fire suppression systems shall be installed where people would otherwise be:
(a) Unlikely to reach a safe place in adequate time because of the number of storeys in the building,
(b) Required to remain within the building without proceeding directly to a final exit, or where evacuation time is excessive,
(c) Unlikely to reach a safe place due to confinement under institutional care because of mental or physical disability, illness or legal detention, and the evacuation time is excessive, or
(d) At high risk due to the fire load and fire hazard within the building.

C3.3.7 Air conditioning and mechanical ventilation systems shall be constructed to avoid circulation of smoke and fire between the firecells.
C3.3.8 Where an automatic smoke control system is installed, it shall be constructed to:
(a) Avoid the spread of fire and smoke between firecell, and
(b) Protect escape routes from smoke until the occupants have reached a safe place.

C3.3.9 The fire safety systems installed shall facilitate the specific needs of the fire service personnel to:
(a) Carry out rescue operations, and
(b) Control the spread of fire.

C3.3.10 Environmental protection systems shall ensure a low probability of hazardous substances being released to:
(a) Soils, vegetation or natural waters,
(b) The atmosphere, and
(c) Sewers or public drains.

Clause C4-STRUCTURAL STABILITY DURING FIRE

OBJECTIVE

C4.1 The objective of this provision is to:

(a) Safeguard people from injury due to loss of structural stability during fire, and

(b) Protect household units and other property from damage due to structural instability caused by fire.

FUNCTIONAL REQUIREMENT

C4.2 Buildings shall be constructed to maintain structural stability during fire to:

(a) Allow people adequate time to evacuate safely,

(b) Allow fire service personnel adequate time to undertake rescue and fire fighting operations, and

(c) Avoid collapse and consequential damage to adjacent household units or other property.

PERFORMANCE

C4.3.1 Structural elements of buildings shall have fire resistance appropriate to the function of the elements, the fire load, the fire intensity, the fire hazard, the height of the buildings and the fire control facilities external to and within them.

C4.3.2 Structural elements shall have fire resistance of no less than that of any element to which they provide support within the same firecell.

C4.3.3 Collapse of elements having lesser fire resistance shall not cause the consequential collapse of elements required to have a higher fire resistance.

Appendix B

Sum of the Squares for the Best Fit Lines

Experiment	**Best fit Line A**	**Best fit Line B**	**Best fit Line C**	**Best fit Line D**	**Best fit Line E**
Doorway Experiments					
700mm	24.5422	21.1119	18.8454	*17.9738*	19.6273
850mm	27.2242	22.2512	17.5657	*14.1867*	16.0534
1000mm	19.0363	16.5334	*16.1397*	16.9837	18.7401
1150mm	6.5215	*6.3529*	7.3192	8.7796	9.9129
1300mm	7.923	6.8591	*6.4546*	6.5879	7.1188
1500mm	9.7316	*8.6155*	9.0423	10.892	11.2185
Corner	*5.3042*	5.3231	6.0415	7.1935	7.7318
Opposed Flow					
Main Flow 1 Person Opposing	*4.6074*	4.7884	5.098	5.4194	5.9017
Main Flow 3 People Opposing	*7.7818*	8.4362	9.1933	9.9261	10.8327
Minor Flow 1 Person Opposing	*5.6609*	6.3404	7.025	7.7856	8.4177
Minor Flow 3 People Opposing	*8.3919*	8.3979	8.7083	9.1445	9.7584
Equal Flows	7.1053	6.731	*6.5885*	6.6165	7.2041
Over all Best Fit Line	133.8303	121.741	**118.0215**	121.4893	132.5174

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 700mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2282	0.3893	0.0000	0.0000	0.0000	0.0000	0.0000	0.1516	0.1516	0.1516	0.1516	0.1516
0.2295	0.3873	0.0000	0.0000	0.0000	0.0000	0.0000	0.1500	0.1500	0.1500	0.1500	0.1500
0.2465	0.2717	0.0000	0.0000	0.0000	0.0000	0.0000	0.0738	0.0738	0.0738	0.0738	0.0738
0.2627	0.4011	0.0000	0.0000	0.0000	0.0000	0.0000	0.1608	0.1608	0.1608	0.1608	0.1608
0.2652	0.5765	0.0000	0.0000	0.0000	0.0000	0.0000	0.3323	0.3323	0.3323	0.3323	0.3323
0.2742	0.6360	0.0000	0.0000	0.0000	0.0000	0.0000	0.4045	0.4045	0.4045	0.4045	0.4045
0.2774	0.3231	0.0000	0.0000	0.0000	0.0000	0.0000	0.1044	0.1044	0.1044	0.1044	0.1044
0.2782	0.4823	0.0000	0.0000	0.0000	0.0000	0.0000	0.2326	0.2326	0.2326	0.2326	0.2326
0.2966	0.6617	0.0000	0.0000	0.0000	0.0000	0.0000	0.4379	0.4379	0.4379	0.4379	0.4379
0.3008	0.3628	0.0038	0.0030	0.0025	0.0022	0.0019	0.1289	0.1295	0.1298	0.1301	0.1302
0.3111	0.9300	0.0523	0.0418	0.0349	0.0299	0.0266	0.7704	0.7888	0.8012	0.8102	0.8160
0.3244	0.9157	0.1148	0.0919	0.0766	0.0657	0.0586	0.6414	0.6786	0.7041	0.7225	0.7347
0.3312	0.8219	0.1467	0.1174	0.0979	0.0839	0.0749	0.4559	0.4963	0.5241	0.5446	0.5580
0.3375	0.3263	0.1761	0.1410	0.1176	0.1009	0.0900	0.0226	0.0343	0.0436	0.0508	0.0558
0.3497	0.6353	0.2327	0.1866	0.1557	0.1336	0.1193	0.1621	0.2013	0.2300	0.2517	0.2663
0.3584	0.4466	0.2728	0.2189	0.1828	0.1568	0.1402	0.0302	0.0518	0.0696	0.0840	0.0939
0.3617	0.5661	0.2879	0.2311	0.1930	0.1656	0.1481	0.0774	0.1122	0.1392	0.1604	0.1748
0.3623	1.0284	0.2907	0.2334	0.1949	0.1672	0.1495	0.5442	0.6320	0.6948	0.7416	0.7724
0.3651	0.5381	0.3034	0.2437	0.2035	0.1747	0.1562	0.0550	0.0866	0.1119	0.1320	0.1458
0.3704	0.4321	0.3275	0.2632	0.2199	0.1888	0.1690	0.0109	0.0285	0.0450	0.0592	0.0693
0.3706	0.7462	0.3284	0.2640	0.2205	0.1893	0.1694	0.1745	0.2326	0.2764	0.3102	0.3327
0.3832	1.0509	0.3851	0.3101	0.2593	0.2227	0.1997	0.4432	0.5487	0.6265	0.6858	0.7245
0.3861	0.6603	0.3981	0.3206	0.2682	0.2304	0.2066	0.0688	0.1153	0.1537	0.1848	0.2058
0.4062	0.6963	0.4861	0.3930	0.3294	0.2833	0.2549	0.0442	0.0920	0.1346	0.1706	0.1948
0.4108	0.9140	0.5058	0.4093	0.3432	0.2953	0.2659	0.1666	0.2547	0.3258	0.3828	0.4200
0.4119	0.3284	0.5105	0.4132	0.3465	0.2982	0.2686	0.0332	0.0072	0.0003	0.0009	0.0036
0.4131	0.5562	0.5156	0.4175	0.3501	0.3013	0.2714	0.0016	0.0192	0.0425	0.0650	0.0811
0.4158	0.8661	0.5271	0.4270	0.3582	0.3083	0.2779	0.1150	0.1929	0.2580	0.3112	0.3460
0.4502	0.5445	0.6675	0.5455	0.4598	0.3968	0.3605	0.0151	0.0000	0.0072	0.0218	0.0339
0.4570	0.4666	0.6939	0.5682	0.4795	0.4141	0.3768	0.0517	0.0103	0.0002	0.0028	0.0081
0.4695	0.8136	0.7411	0.6092	0.5152	0.4455	0.4068	0.0053	0.0418	0.0890	0.1355	0.1655
0.4763	0.6651	0.7660	0.6312	0.5344	0.4625	0.4231	0.0102	0.0012	0.0171	0.0411	0.0586
0.4816	0.2663	0.7851	0.6481	0.5493	0.4756	0.4358	0.2691	0.1457	0.0800	0.0438	0.0287
0.5009	0.4600	0.8515	0.7081	0.6024	0.5228	0.4822	0.1533	0.0616	0.0203	0.0040	0.0005
0.5025	0.6692	0.8568	0.7129	0.6068	0.5267	0.4860	0.0352	0.0019	0.0039	0.0203	0.0336
0.5082	0.3054	0.8754	0.7301	0.6222	0.5405	0.4997	0.3249	0.1804	0.1003	0.0553	0.0377
0.5125	0.3528	0.8891	0.7429	0.6337	0.5508	0.5100	0.2877	0.1522	0.0789	0.0392	0.0247
0.5139	0.7690	0.8936	0.7471	0.6374	0.5541	0.5134	0.0155	0.0005	0.0173	0.0462	0.0654
0.5158	0.6754	0.8995	0.7526	0.6425	0.5587	0.5179	0.0502	0.0060	0.0011	0.0136	0.0248
0.5159	1.0977	0.8998	0.7529	0.6427	0.5589	0.5182	0.0392	0.1189	0.2070	0.2903	0.3359
0.5165	0.9203	0.9017	0.7547	0.6443	0.5603	0.5196	0.0003	0.0274	0.0762	0.1296	0.1605
0.5166	0.9858	0.9020	0.7550	0.6446	0.5606	0.5198	0.0070	0.0533	0.1164	0.1808	0.2171
0.5176	0.5326	0.9051	0.7579	0.6472	0.5629	0.5222	0.1387	0.0507	0.0131	0.0009	0.0001
0.5224	0.9600	0.9198	0.7719	0.6599	0.5743	0.5338	0.0016	0.0354	0.0901	0.1487	0.1817
0.5300	0.5683	0.9424	0.7936	0.6797	0.5922	0.5520	0.1399	0.0507	0.0124	0.0006	0.0003
0.5306	0.5274	0.9441	0.7953	0.6812	0.5936	0.5534	0.1737	0.0718	0.0237	0.0044	0.0007
0.5314	0.8941	0.9465	0.7975	0.6833	0.5955	0.5554	0.0027	0.0093	0.0444	0.0892	0.1148
0.5345	0.2585	0.9554	0.8062	0.6913	0.6027	0.5628	0.4856	0.3000	0.1873	0.1185	0.0926
0.5388	0.1523	0.9675	0.8182	0.7023	0.6127	0.5731	0.6646	0.4434	0.3025	0.2120	0.1771

0.5395	0.5312	0.9694	0.8201	0.7041	0.6143	0.5748	0.1920	0.0834	0.0299	0.0069	0.0019
0.5404	0.5484	0.9719	0.8226	0.7064	0.6164	0.5770	0.1794	0.0752	0.0249	0.0046	0.0008
0.5404	0.5484	0.9719	0.8226	0.7064	0.6164	0.5770	0.1794	0.0752	0.0249	0.0046	0.0008
0.5423	0.2811	0.9772	0.8278	0.7112	0.6208	0.5815	0.4845	0.2989	0.1850	0.1154	0.0903
0.5455	1.4910	0.9858	0.8364	0.7192	0.6281	0.5892	0.2552	0.4284	0.5956	0.7445	0.8132
0.5458	0.8560	0.9866	0.8373	0.7200	0.6288	0.5899	0.0171	0.0004	0.0185	0.0516	0.0708
0.5472	0.6456	0.9904	0.8410	0.7235	0.6320	0.5933	0.1189	0.0382	0.0061	0.0002	0.0027
0.5472	0.6456	0.9904	0.8410	0.7235	0.6320	0.5933	0.1189	0.0382	0.0061	0.0002	0.0027
0.5517	0.6074	1.0022	0.8530	0.7347	0.6423	0.6041	0.1559	0.0603	0.0162	0.0012	0.0000
0.5629	0.6979	1.0302	0.8822	0.7622	0.6676	0.6310	0.1104	0.0340	0.0041	0.0009	0.0045
0.5644	0.4383	1.0338	0.8860	0.7659	0.6709	0.6346	0.3546	0.2004	0.1073	0.0541	0.0385
0.5652	0.8104	1.0358	0.8881	0.7678	0.6727	0.6365	0.0508	0.0060	0.0018	0.0189	0.0302
0.5747	0.4794	1.0576	0.9118	0.7905	0.6937	0.6593	0.3343	0.1869	0.0968	0.0459	0.0323
0.5769	0.2135	1.0625	0.9171	0.7957	0.6986	0.6646	0.7209	0.4951	0.3390	0.2353	0.2035
0.5852	0.8351	1.0801	0.9370	0.8150	0.7166	0.6845	0.0600	0.0104	0.0004	0.0140	0.0227
0.5880	0.9979	1.0858	0.9435	0.8215	0.7227	0.6912	0.0077	0.0030	0.0311	0.0758	0.0941
0.5908	0.4499	1.0913	0.9500	0.8278	0.7287	0.6979	0.4114	0.2501	0.1428	0.0777	0.0615
0.5936	0.3782	1.0968	0.9564	0.8342	0.7346	0.7046	0.5164	0.3344	0.2080	0.1271	0.1066
0.5941	0.7959	1.0977	0.9576	0.8353	0.7357	0.7058	0.0911	0.0261	0.0016	0.0036	0.0081
0.5973	1.1945	1.1037	0.9648	0.8425	0.7425	0.7135	0.0082	0.0527	0.1239	0.2043	0.2313
0.6016	0.9449	1.1115	0.9744	0.8521	0.7516	0.7238	0.0278	0.0009	0.0086	0.0374	0.0489
0.6045	1.0854	1.1166	0.9807	0.8585	0.7576	0.7308	0.0010	0.0110	0.0515	0.1075	0.1258
0.6070	1.6139	1.1209	0.9861	0.8639	0.7628	0.7368	0.2431	0.3941	0.5624	0.7243	0.7693
0.6070	1.6139	1.1209	0.9861	0.8639	0.7628	0.7368	0.2431	0.3941	0.5624	0.7243	0.7693
0.6077	0.7831	1.1220	0.9876	0.8655	0.7643	0.7385	0.1149	0.0418	0.0068	0.0004	0.0020
0.6103	0.2452	1.1263	0.9931	0.8711	0.7697	0.7447	0.7764	0.5594	0.3918	0.2751	0.2495
0.6141	0.4902	1.1324	1.0011	0.8793	0.7775	0.7538	0.4124	0.2610	0.1514	0.0826	0.0695
0.6205	0.6919	1.1420	1.0142	0.8928	0.7905	0.7692	0.2026	0.1039	0.0404	0.0097	0.0060
0.6208	1.0554	1.1424	1.0148	0.8935	0.7911	0.7699	0.0076	0.0016	0.0262	0.0698	0.0815
0.6253	1.4511	1.1487	1.0238	0.9028	0.8002	0.7807	0.0914	0.1826	0.3006	0.4236	0.4494
0.6288	0.4527	1.1534	1.0306	0.9100	0.8072	0.7891	0.4910	0.3339	0.2092	0.1257	0.1132
0.6421	0.8067	1.1691	1.0554	0.9367	0.8334	0.8210	0.1313	0.0618	0.0169	0.0007	0.0002
0.6421	0.8067	1.1691	1.0554	0.9367	0.8334	0.8210	0.1313	0.0618	0.0169	0.0007	0.0002
0.6476	0.9278	1.1747	1.0651	0.9474	0.8439	0.8342	0.0609	0.0188	0.0004	0.0070	0.0088
0.6524	0.8306	1.1791	1.0733	0.9566	0.8531	0.8458	0.1214	0.0589	0.0159	0.0005	0.0002
0.6539	0.9305	1.1804	1.0758	0.9594	0.8559	0.8494	0.0624	0.0211	0.0008	0.0056	0.0066
0.6559	0.8503	1.1821	1.0791	0.9632	0.8597	0.8542	0.1101	0.0524	0.0128	0.0001	0.0000
0.6606	1.2548	1.1857	1.0868	0.9719	0.8685	0.8654	0.0048	0.0282	0.0800	0.1493	0.1516
0.6647	0.9246	1.1885	1.0932	0.9794	0.8761	0.8753	0.0696	0.0284	0.0030	0.0024	0.0024
0.6649	0.4078	1.1886	1.0935	0.9798	0.8764	0.8758	0.6096	0.4702	0.3271	0.2196	0.2190
0.6731	0.6562	1.1933	1.1059	0.9944	0.8914	0.8954	0.2885	0.2022	0.1144	0.0553	0.0572
0.6732	0.8323	1.1934	1.1060	0.9946	0.8915	0.8957	0.1303	0.0749	0.0263	0.0035	0.0040
0.6924	0.9327	1.1995	1.1321	1.0271	0.9253	0.9418	0.0712	0.0398	0.0089	0.0001	0.0001
0.7011	1.1272	1.2000	1.1425	1.0410	0.9400	0.9626	0.0053	0.0002	0.0074	0.0350	0.0271
0.7103	0.6373	1.2000	1.1527	1.0550	0.9552	0.9847	0.3166	0.2656	0.1745	0.1011	0.1207
0.7108	0.6609	1.2000	1.1532	1.0558	0.9561	0.9859	0.2906	0.2424	0.1559	0.0871	0.1056
0.7123	0.4451	1.2000	1.1547	1.0580	0.9585	0.9895	0.5698	0.5035	0.3756	0.2635	0.2964
0.7239	1.1939	1.2000	1.1659	1.0747	0.9770	1.0174	0.0000	0.0008	0.0142	0.0471	0.0312
0.7256	0.7535	1.2000	1.1674	1.0771	0.9796	1.0214	0.1993	0.1713	0.1047	0.0511	0.0718
0.7259	0.7558	1.2000	1.1676	1.0775	0.9801	1.0222	0.1973	0.1696	0.1035	0.0503	0.0709
0.7294	0.7909	1.2000	1.1706	1.0823	0.9855	1.0306	0.1674	0.1442	0.0849	0.0379	0.0574
0.7322	0.8826	1.2000	1.1729	1.0861	0.9898	1.0373	0.1007	0.0842	0.0414	0.0115	0.0239
0.7352	0.7956	1.2000	1.1752	1.0900	0.9943	1.0445	0.1635	0.1441	0.0867	0.0395	0.0619
0.7367	0.6557	1.2000	1.1764	1.0920	0.9966	1.0481	0.2963	0.2711	0.1904	0.1162	0.1540
0.7410	0.8003	1.2000	1.1794	1.0975	1.0030	1.0584	0.1598	0.1438	0.0883	0.0411	0.0666
0.7468	0.8050	1.2000	1.1833	1.1048	1.0114	1.0723	0.1560	0.1431	0.0899	0.0426	0.0715
0.7512	0.9790	1.2000	1.1859	1.1101	1.0178	1.0829	0.0488	0.0428	0.0172	0.0015	0.0108

0.7526	0.8097	1.2000	1.1867	1.1117	1.0198	1.0862	0.1523	0.1421	0.0912	0.0441	0.0765
0.7579	0.9120	1.2000	1.1895	1.1179	1.0272	1.0990	0.0830	0.0770	0.0424	0.0133	0.0350
0.7579	0.9120	1.2000	1.1895	1.1179	1.0272	1.0990	0.0830	0.0770	0.0424	0.0133	0.0350
0.7584	0.8144	1.2000	1.1898	1.1185	1.0279	1.1001	0.1487	0.1409	0.0925	0.0456	0.0816
0.7606	0.6047	1.2000	1.1908	1.1210	1.0310	1.1054	0.3544	0.3436	0.2666	0.1817	0.2508
0.7642	0.8191	1.2000	1.1924	1.1249	1.0359	1.1140	0.1451	0.1393	0.0935	0.0470	0.0870
0.7689	0.8390	1.2000	1.1943	1.1300	1.0422	1.1254	0.1303	0.1262	0.0847	0.0413	0.0820
0.7700	0.8238	1.2000	1.1947	1.1312	1.0437	1.1280	0.1415	0.1375	0.0944	0.0483	0.0925
0.7713	1.1169	1.2000	1.1951	1.1325	1.0454	1.1311	0.0069	0.0061	0.0002	0.0051	0.0002
0.7739	0.9648	1.2000	1.1960	1.1352	1.0488	1.1374	0.0553	0.0534	0.0290	0.0071	0.0298
0.7758	0.8285	1.2000	1.1965	1.1371	1.0513	1.1419	0.1380	0.1354	0.0952	0.0496	0.0982
0.7816	0.8332	1.2000	1.1980	1.1428	1.0587	1.1558	0.1345	0.1330	0.0958	0.0508	0.1040
0.7821	0.9233	1.2000	1.1981	1.1433	1.0594	1.1570	0.0765	0.0755	0.0484	0.0185	0.0546
0.7871	0.7479	1.2000	1.1990	1.1480	1.0656	1.1690	0.2044	0.2035	0.1600	0.1009	0.1773
0.7921	0.8201	1.2000	1.1996	1.1524	1.0718	1.1810	0.1444	0.1441	0.1105	0.0634	0.1303
0.7957	1.1365	1.2000	1.1999	1.1555	1.0761	1.1897	0.0040	0.0040	0.0004	0.0036	0.0028
0.8411	1.0704	1.2000	1.2000	1.1858	1.1245	1.2000	0.0168	0.0168	0.0133	0.0029	0.0168
0.8494	1.1409	1.2000	1.2000	1.1895	1.1321	1.2000	0.0035	0.0035	0.0024	0.0001	0.0035
0.8590	0.7875	1.2000	1.2000	1.1931	1.1404	1.2000	0.1702	0.1702	0.1645	0.1246	0.1702
0.8741	0.9560	1.2000	1.2000	1.1972	1.1524	1.2000	0.0595	0.0595	0.0582	0.0386	0.0595
0.8783	0.6910	1.2000	1.2000	1.1981	1.1555	1.2000	0.2591	0.2591	0.2572	0.2158	0.2591
0.8797	0.6012	1.2000	1.2000	1.1983	1.1565	1.2000	0.3585	0.3585	0.3565	0.3084	0.3585
0.8901	1.0226	1.2000	1.2000	1.1996	1.1637	1.2000	0.0315	0.0315	0.0313	0.0199	0.0315
0.8901	1.0226	1.2000	1.2000	1.1996	1.1637	1.2000	0.0315	0.0315	0.0313	0.0199	0.0315
0.8912	1.5740	1.2000	1.2000	1.1997	1.1644	1.2000	0.1399	0.1399	0.1401	0.1677	0.1399
0.8957	1.1268	1.2000	1.2000	1.1999	1.1673	1.2000	0.0054	0.0054	0.0054	0.0016	0.0054
0.9618	1.3168	1.2000	1.2000	1.2000	1.1956	1.2000	0.0136	0.0136	0.0136	0.0147	0.0136
0.9621	1.2382	1.2000	1.2000	1.2000	1.1957	1.2000	0.0015	0.0015	0.0015	0.0018	0.0015
1.0253	0.9571	1.2000	1.2000	1.2000	1.2000	1.2000	0.0590	0.0590	0.0590	0.0590	0.0590
1.1524	0.8932	1.2000	1.2000	1.2000	1.2000	1.2000	0.0941	0.0941	0.0941	0.0941	0.0941
1.1713	1.1740	1.2000	1.2000	1.2000	1.2000	1.2000	0.0007	0.0007	0.0007	0.0007	0.0007
1.1828	1.2311	1.2000	1.2000	1.2000	1.2000	1.2000	0.0010	0.0010	0.0010	0.0010	0.0010
1.2162	1.2891	1.2000	1.2000	1.2000	1.2000	1.2000	0.0079	0.0079	0.0079	0.0079	0.0079
1.2350	1.3425	1.2000	1.2000	1.2000	1.2000	1.2000	0.0203	0.0203	0.0203	0.0203	0.0203
1.3230	0.8300	1.2000	1.2000	1.2000	1.2000	1.2000	0.1369	0.1369	0.1369	0.1369	0.1369
1.3700	0.8871	1.2000	1.2000	1.2000	1.2000	1.2000	0.0979	0.0979	0.0979	0.0979	0.0979
1.3872	1.5276	1.2000	1.2000	1.2000	1.2000	1.2000	0.1073	0.1073	0.1073	0.1073	0.1073
1.3882	1.1928	1.2000	1.2000	1.2000	1.2000	1.2000	0.0001	0.0001	0.0001	0.0001	0.0001
1.4334	1.2174	1.2000	1.2000	1.2000	1.2000	1.2000	0.0003	0.0003	0.0003	0.0003	0.0003
1.4345	1.1754	1.2000	1.2000	1.2000	1.2000	1.2000	0.0006	0.0006	0.0006	0.0006	0.0006
1.4429	1.3990	1.2000	1.2000	1.2000	1.2000	1.2000	0.0396	0.0396	0.0396	0.0396	0.0396
1.4615	1.2411	1.2000	1.2000	1.2000	1.2000	1.2000	0.0017	0.0017	0.0017	0.0017	0.0017
1.4629	1.1873	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.4673	1.2489	1.2000	1.2000	1.2000	1.2000	1.2000	0.0024	0.0024	0.0024	0.0024	0.0024
1.4673	1.2489	1.2000	1.2000	1.2000	1.2000	1.2000	0.0024	0.0024	0.0024	0.0024	0.0024
1.4682	1.4042	1.2000	1.2000	1.2000	1.2000	1.2000	0.0417	0.0417	0.0417	0.0417	0.0417
1.4767	1.3531	1.2000	1.2000	1.2000	1.2000	1.2000	0.0235	0.0235	0.0235	0.0235	0.0235
1.5300	1.1720	1.2000	1.2000	1.2000	1.2000	1.2000	0.0008	0.0008	0.0008	0.0008	0.0008
1.5729	0.8988	1.2000	1.2000	1.2000	1.2000	1.2000	0.0907	0.0907	0.0907	0.0907	0.0907
1.6162	1.4015	1.2000	1.2000	1.2000	1.2000	1.2000	0.0406	0.0406	0.0406	0.0406	0.0406
1.6224	1.0916	1.2000	1.2000	1.2000	1.2000	1.2000	0.0118	0.0118	0.0118	0.0118	0.0118
1.6262	1.4749	1.2000	1.2000	1.2000	1.2000	1.2000	0.0756	0.0756	0.0756	0.0756	0.0756
1.6600	1.4237	1.2000	1.2000	1.2000	1.2000	1.2000	0.0500	0.0500	0.0500	0.0500	0.0500
1.7534	0.9919	1.2000	1.2000	1.2000	1.2000	1.2000	0.0433	0.0433	0.0433	0.0433	0.0433
1.7986	0.8977	1.2000	1.2000	1.2000	1.2000	1.2000	0.0914	0.0914	0.0914	0.0914	0.0914
1.8344	1.0628	1.2000	1.2000	1.2000	1.2000	1.2000	0.0188	0.0188	0.0188	0.0188	0.0188
1.8802	1.2440	1.2000	1.2000	1.2000	1.2000	1.2000	0.0019	0.0019	0.0019	0.0019	0.0019

1.8987	0.9744	1.2000	1.2000	1.2000	1.2000	1.2000	0.0509	0.0509	0.0509	0.0509	0.0509
1.9230	1.0452	1.2000	1.2000	1.2000	1.2000	1.2000	0.0240	0.0240	0.0240	0.0240	0.0240
1.9778	1.1296	1.2000	1.2000	1.2000	1.2000	1.2000	0.0050	0.0050	0.0050	0.0050	0.0050
							24.5422	21.1119	18.8454	17.9738	19.6273

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 850mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.3522	0.7511	0.2443	0.1959	0.1635	0.1402	0.1253	0.2569	0.3083	0.3453	0.3732	0.3917
0.3878	0.7827	0.4056	0.3268	0.2734	0.2349	0.2107	0.1422	0.2078	0.2594	0.3001	0.3272
0.3910	0.5720	0.4198	0.3384	0.2832	0.2433	0.2184	0.0232	0.0546	0.0834	0.1080	0.1250
0.4310	0.8940	0.5905	0.4800	0.4035	0.3477	0.3144	0.0921	0.1714	0.2406	0.2984	0.3359
0.4360	0.6510	0.6108	0.4973	0.4183	0.3606	0.3264	0.0016	0.0236	0.0542	0.0844	0.1054
0.4622	0.6129	0.7137	0.5854	0.4944	0.4272	0.3893	0.0102	0.0008	0.0140	0.0345	0.0500
0.4710	0.9230	0.7466	0.6141	0.5194	0.4493	0.4104	0.0311	0.0954	0.1629	0.2244	0.2628
0.4845	0.3327	0.7953	0.6573	0.5573	0.4827	0.4428	0.2140	0.1053	0.0504	0.0225	0.0121
0.4928	0.8170	0.8242	0.6832	0.5803	0.5031	0.4627	0.0001	0.0179	0.0560	0.0985	0.1255
0.5343	0.3516	0.9548	0.8057	0.6908	0.6023	0.5623	0.3638	0.2061	0.1150	0.0628	0.0444
0.5371	0.4526	0.9627	0.8135	0.6980	0.6088	0.5690	0.2602	0.1302	0.0602	0.0244	0.0136
0.5403	0.5478	0.9717	0.8223	0.7061	0.6162	0.5767	0.1796	0.0753	0.0250	0.0047	0.0008
0.5417	0.6976	0.9755	0.8261	0.7097	0.6194	0.5801	0.0772	0.0165	0.0001	0.0061	0.0138
0.5425	0.5199	0.9777	0.8283	0.7117	0.6212	0.5820	0.2095	0.0951	0.0368	0.0103	0.0039
0.5470	1.1387	0.9898	0.8405	0.7230	0.6316	0.5928	0.0222	0.0889	0.1728	0.2571	0.2980
0.5556	0.5879	1.0122	0.8633	0.7444	0.6512	0.6134	0.1801	0.0759	0.0245	0.0040	0.0007
0.5606	0.7080	1.0246	0.8763	0.7566	0.6624	0.6254	0.1003	0.0283	0.0024	0.0021	0.0068
0.5607	0.7887	1.0249	0.8766	0.7569	0.6626	0.6257	0.0558	0.0077	0.0010	0.0159	0.0266
0.5648	0.7157	1.0348	0.8870	0.7668	0.6718	0.6355	0.1019	0.0294	0.0026	0.0019	0.0064
0.5653	0.9948	1.0360	0.8883	0.7681	0.6729	0.6367	0.0017	0.0113	0.0514	0.1036	0.1282
0.5657	0.3831	1.0369	0.8893	0.7690	0.6738	0.6377	0.4275	0.2563	0.1489	0.0845	0.0648
0.5673	0.6416	1.0407	0.8934	0.7729	0.6774	0.6415	0.1593	0.0634	0.0172	0.0013	0.0000
0.5760	0.9184	1.0605	0.9149	0.7936	0.6966	0.6624	0.0202	0.0000	0.0156	0.0492	0.0655
0.5803	0.3894	1.0698	0.9253	0.8037	0.7060	0.6727	0.4629	0.2872	0.1716	0.1002	0.0802
0.5870	0.4286	1.0838	0.9412	0.8192	0.7205	0.6888	0.4292	0.2627	0.1525	0.0852	0.0677
0.5932	0.7015	1.0960	0.9555	0.8333	0.7338	0.7037	0.1556	0.0645	0.0174	0.0010	0.0000
0.5974	0.6531	1.1039	0.9650	0.8427	0.7427	0.7138	0.2032	0.0973	0.0359	0.0080	0.0037
0.6000	0.4798	1.1087	0.9708	0.8485	0.7482	0.7200	0.3955	0.2411	0.1360	0.0720	0.0577
0.6031	0.3423	1.1142	0.9776	0.8554	0.7547	0.7274	0.5958	0.4037	0.2633	0.1701	0.1483
0.6159	0.4034	1.1351	1.0048	0.8831	0.7812	0.7582	0.5355	0.3617	0.2301	0.1427	0.1259
0.6184	0.7273	1.1389	1.0099	0.8884	0.7863	0.7642	0.1694	0.0799	0.0259	0.0035	0.0014
0.6184	0.7273	1.1389	1.0099	0.8884	0.7863	0.7642	0.1694	0.0799	0.0259	0.0035	0.0014
0.6237	0.6472	1.1465	1.0206	0.8995	0.7970	0.7769	0.2494	0.1394	0.0637	0.0224	0.0168
0.6272	0.8694	1.1513	1.0275	0.9067	0.8040	0.7853	0.0795	0.0250	0.0014	0.0043	0.0071
0.6277	0.7991	1.1520	1.0284	0.9078	0.8050	0.7865	0.1245	0.0526	0.0118	0.0000	0.0002
0.6298	0.4070	1.1547	1.0325	0.9121	0.8092	0.7915	0.5591	0.3913	0.2551	0.1618	0.1479
0.6312	0.6637	1.1565	1.0352	0.9149	0.8120	0.7949	0.2429	0.1380	0.0631	0.0220	0.0172
0.6317	0.7545	1.1571	1.0361	0.9159	0.8130	0.7961	0.1621	0.0793	0.0261	0.0034	0.0017
0.6376	0.7579	1.1642	1.0472	0.9278	0.8246	0.8102	0.1651	0.0837	0.0289	0.0045	0.0027
0.6393	0.8236	1.1661	1.0503	0.9312	0.8279	0.8143	0.1173	0.0514	0.0116	0.0000	0.0001
0.6439	1.1450	1.1710	1.0586	0.9402	0.8368	0.8254	0.0007	0.0075	0.0419	0.0949	0.1021
0.6478	0.9037	1.1749	1.0654	0.9478	0.8443	0.8347	0.0735	0.0261	0.0019	0.0035	0.0048
0.6515	0.8804	1.1783	1.0718	0.9549	0.8514	0.8436	0.0888	0.0366	0.0056	0.0008	0.0014
0.6536	0.2982	1.1801	1.0753	0.9589	0.8554	0.8486	0.7779	0.6039	0.4365	0.3105	0.3030
0.6581	0.9955	1.1838	1.0827	0.9673	0.8638	0.8594	0.0355	0.0076	0.0008	0.0173	0.0185
0.6584	0.3705	1.1840	1.0832	0.9679	0.8644	0.8602	0.6618	0.5079	0.3568	0.2439	0.2397
0.6612	0.4113	1.1861	1.0877	0.9730	0.8696	0.8669	0.6004	0.4576	0.3156	0.2101	0.2076
0.6644	0.3256	1.1883	1.0928	0.9789	0.8755	0.8746	0.7443	0.5886	0.4268	0.3024	0.3014
0.6659	1.0986	1.1893	1.0951	0.9816	0.8783	0.8782	0.0082	0.0000	0.0137	0.0486	0.0486

0.6701	0.7990	1.1917	1.1015	0.9891	0.8859	0.8882	0.1542	0.0915	0.0361	0.0076	0.0080
0.6776	0.4253	1.1954	1.1124	1.0023	0.8994	0.9062	0.5930	0.4721	0.3329	0.2248	0.2313
0.6776	0.9459	1.1954	1.1124	1.0023	0.8994	0.9062	0.0623	0.0277	0.0032	0.0022	0.0016
0.6787	0.9873	1.1958	1.1139	1.0042	0.9014	0.9089	0.0435	0.0160	0.0003	0.0074	0.0061
0.6834	0.4710	1.1975	1.1204	1.0122	0.9097	0.9202	0.5277	0.4217	0.2929	0.1925	0.2018
0.6856	0.4658	1.1981	1.1233	1.0159	0.9135	0.9254	0.5362	0.4324	0.3026	0.2005	0.2113
0.6886	0.3970	1.1988	1.1273	1.0209	0.9188	0.9326	0.6429	0.5333	0.3892	0.2723	0.2869
0.6895	0.6236	1.1990	1.1284	1.0223	0.9203	0.9348	0.3311	0.2549	0.1590	0.0881	0.0969
0.6932	0.9154	1.1996	1.1331	1.0284	0.9267	0.9437	0.0807	0.0474	0.0128	0.0001	0.0008
0.6932	0.9154	1.1996	1.1331	1.0284	0.9267	0.9437	0.0807	0.0474	0.0128	0.0001	0.0008
0.6936	0.9069	1.1996	1.1336	1.0290	0.9274	0.9446	0.0857	0.0514	0.0149	0.0004	0.0014
0.6936	0.9069	1.1996	1.1336	1.0290	0.9274	0.9446	0.0857	0.0514	0.0149	0.0004	0.0014
0.6937	1.0601	1.1996	1.1337	1.0292	0.9275	0.9449	0.0195	0.0054	0.0010	0.0176	0.0133
0.6939	0.7195	1.1997	1.1340	1.0295	0.9279	0.9454	0.2306	0.1718	0.0961	0.0434	0.0510
0.6947	1.0738	1.1997	1.1349	1.0308	0.9292	0.9473	0.0159	0.0037	0.0018	0.0209	0.0160
0.6957	0.9199	1.1998	1.1362	1.0324	0.9309	0.9497	0.0783	0.0468	0.0127	0.0001	0.0009
0.6988	0.9370	1.2000	1.1399	1.0373	0.9362	0.9571	0.0692	0.0411	0.0101	0.0000	0.0004
0.7042	0.7901	1.2000	1.1461	1.0458	0.9452	0.9701	0.1680	0.1267	0.0653	0.0240	0.0324
0.7124	0.7784	1.2000	1.1548	1.0582	0.9587	0.9898	0.1778	0.1417	0.0783	0.0325	0.0447
0.7154	0.9782	1.2000	1.1579	1.0626	0.9635	0.9970	0.0492	0.0323	0.0071	0.0002	0.0004
0.7161	0.4886	1.2000	1.1586	1.0636	0.9646	0.9986	0.5062	0.4489	0.3307	0.2266	0.2602
0.7166	0.4263	1.2000	1.1590	1.0643	0.9654	0.9998	0.5986	0.5369	0.4070	0.2906	0.3289
0.7176	0.7008	1.2000	1.1600	1.0658	0.9670	1.0022	0.2492	0.2109	0.1332	0.0709	0.0909
0.7179	0.8196	1.2000	1.1603	1.0662	0.9675	1.0030	0.1447	0.1161	0.0608	0.0219	0.0336
0.7250	0.6133	1.2000	1.1668	1.0762	0.9787	1.0200	0.3442	0.3064	0.2143	0.1335	0.1654
0.7279	0.8809	1.2000	1.1693	1.0802	0.9832	1.0270	0.1018	0.0832	0.0397	0.0105	0.0213
0.7324	0.5444	1.2000	1.1730	1.0863	0.9901	1.0378	0.4298	0.3952	0.2937	0.1986	0.2434
0.7360	0.5877	1.2000	1.1758	1.0911	0.9955	1.0464	0.3749	0.3459	0.2534	0.1663	0.2104
0.7493	0.7864	1.2000	1.1848	1.1078	1.0151	1.0783	0.1710	0.1587	0.1033	0.0523	0.0852
0.7502	0.9196	1.2000	1.1853	1.1089	1.0164	1.0805	0.0786	0.0706	0.0358	0.0094	0.0259
0.7520	0.8045	1.2000	1.1864	1.1110	1.0189	1.0848	0.1564	0.1458	0.0940	0.0460	0.0786
0.7527	0.7786	1.2000	1.1868	1.1119	1.0199	1.0865	0.1776	0.1666	0.1111	0.0583	0.0948
0.7577	1.2054	1.2000	1.1894	1.1177	1.0269	1.0985	0.0000	0.0003	0.0077	0.0318	0.0114
0.7577	1.2054	1.2000	1.1894	1.1177	1.0269	1.0985	0.0000	0.0003	0.0077	0.0318	0.0114
0.7677	0.4706	1.2000	1.1938	1.1287	1.0406	1.1225	0.5320	0.5230	0.4331	0.3249	0.4249
0.7694	0.7425	1.2000	1.1945	1.1305	1.0429	1.1266	0.2093	0.2043	0.1506	0.0903	0.1475
0.7770	1.2550	1.2000	1.1969	1.1383	1.0529	1.1448	0.0030	0.0034	0.0136	0.0408	0.0121
0.7795	1.0944	1.2000	1.1975	1.1408	1.0561	1.1508	0.0112	0.0106	0.0022	0.0015	0.0032
0.7838	1.0528	1.2000	1.1984	1.1449	1.0615	1.1611	0.0217	0.0212	0.0085	0.0001	0.0117
0.7857	0.5827	1.2000	1.1988	1.1467	1.0639	1.1657	0.3811	0.3796	0.3181	0.2316	0.3399
0.7947	0.7461	1.2000	1.1998	1.1547	1.0749	1.1873	0.2060	0.2059	0.1670	0.1081	0.1947
0.7966	0.6900	1.2000	1.1999	1.1563	1.0772	1.1918	0.2601	0.2600	0.2174	0.1499	0.2518
0.7966	0.6900	1.2000	1.1999	1.1563	1.0772	1.1918	0.2601	0.2600	0.2174	0.1499	0.2518
0.7978	0.6675	1.2000	1.2000	1.1573	1.0786	1.1947	0.2836	0.2836	0.2399	0.1690	0.2780
0.8054	0.7127	1.2000	1.2000	1.1634	1.0874	1.2000	0.2375	0.2375	0.2032	0.1404	0.2375
0.8107	0.7409	1.2000	1.2000	1.1674	1.0934	1.2000	0.2108	0.2108	0.1819	0.1242	0.2108
0.8304	0.5609	1.2000	1.2000	1.1801	1.1141	1.2000	0.4084	0.4084	0.3834	0.3061	0.4084
0.8342	0.8393	1.2000	1.2000	1.1822	1.1179	1.2000	0.1301	0.1301	0.1176	0.0776	0.1301
0.8381	0.8532	1.2000	1.2000	1.1843	1.1217	1.2000	0.1203	0.1203	0.1096	0.0721	0.1203
0.8386	0.9464	1.2000	1.2000	1.1845	1.1222	1.2000	0.0643	0.0643	0.0567	0.0309	0.0643
0.8512	0.0828	1.2000	1.2000	1.1902	1.1337	1.2000	1.2481	1.2481	1.2263	1.1044	1.2481
0.8529	0.7278	1.2000	1.2000	1.1909	1.1352	1.2000	0.2230	0.2230	0.2145	0.1660	0.2230
0.8841	0.4082	1.2000	1.2000	1.1990	1.1596	1.2000	0.6270	0.6270	0.6254	0.5647	0.6270
0.8931	0.5984	1.2000	1.2000	1.1998	1.1656	1.2000	0.3619	0.3619	0.3617	0.3218	0.3619
0.9499	1.1280	1.2000	1.2000	1.2000	1.1924	1.2000	0.0052	0.0052	0.0052	0.0041	0.0052
1.0755	1.5538	1.2000	1.2000	1.2000	1.2000	1.2000	0.1252	0.1252	0.1252	0.1252	0.1252
1.0814	0.8535	1.2000	1.2000	1.2000	1.2000	1.2000	0.1201	0.1201	0.1201	0.1201	0.1201

1.0936	0.7597	1.2000	1.2000	1.2000	1.2000	1.2000	0.1939	0.1939	0.1939	0.1939	0.1939
1.1358	0.8071	1.2000	1.2000	1.2000	1.2000	1.2000	0.1544	0.1544	0.1544	0.1544	0.1544
1.1358	0.8071	1.2000	1.2000	1.2000	1.2000	1.2000	0.1544	0.1544	0.1544	0.1544	0.1544
1.1367	0.7533	1.2000	1.2000	1.2000	1.2000	1.2000	0.1996	0.1996	0.1996	0.1996	0.1996
1.1810	1.0452	1.2000	1.2000	1.2000	1.2000	1.2000	0.0240	0.0240	0.0240	0.0240	0.0240
1.2383	0.8875	1.2000	1.2000	1.2000	1.2000	1.2000	0.0976	0.0976	0.0976	0.0976	0.0976
1.2458	1.2932	1.2000	1.2000	1.2000	1.2000	1.2000	0.0087	0.0087	0.0087	0.0087	0.0087
1.2496	1.2154	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.2668	1.2906	1.2000	1.2000	1.2000	1.2000	1.2000	0.0082	0.0082	0.0082	0.0082	0.0082
1.3037	1.0476	1.2000	1.2000	1.2000	1.2000	1.2000	0.0232	0.0232	0.0232	0.0232	0.0232
1.3274	1.5069	1.2000	1.2000	1.2000	1.2000	1.2000	0.0942	0.0942	0.0942	0.0942	0.0942
1.3371	1.1936	1.2000	1.2000	1.2000	1.2000	1.2000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3538	1.3001	1.2000	1.2000	1.2000	1.2000	1.2000	0.0100	0.0100	0.0100	0.0100	0.0100
1.3811	1.3451	1.2000	1.2000	1.2000	1.2000	1.2000	0.0211	0.0211	0.0211	0.0211	0.0211
1.3958	1.6214	1.2000	1.2000	1.2000	1.2000	1.2000	0.1775	0.1775	0.1775	0.1775	0.1775
1.4086	0.9569	1.2000	1.2000	1.2000	1.2000	1.2000	0.0591	0.0591	0.0591	0.0591	0.0591
1.4107	1.2784	1.2000	1.2000	1.2000	1.2000	1.2000	0.0062	0.0062	0.0062	0.0062	0.0062
1.4243	1.1664	1.2000	1.2000	1.2000	1.2000	1.2000	0.0011	0.0011	0.0011	0.0011	0.0011
1.4282	0.9739	1.2000	1.2000	1.2000	1.2000	1.2000	0.0511	0.0511	0.0511	0.0511	0.0511
1.4307	0.7126	1.2000	1.2000	1.2000	1.2000	1.2000	0.2376	0.2376	0.2376	0.2376	0.2376
1.4481	0.9944	1.2000	1.2000	1.2000	1.2000	1.2000	0.0423	0.0423	0.0423	0.0423	0.0423
1.4890	1.3703	1.2000	1.2000	1.2000	1.2000	1.2000	0.0290	0.0290	0.0290	0.0290	0.0290
1.4943	1.6285	1.2000	1.2000	1.2000	1.2000	1.2000	0.1836	0.1836	0.1836	0.1836	0.1836
1.5114	0.8906	1.2000	1.2000	1.2000	1.2000	1.2000	0.0957	0.0957	0.0957	0.0957	0.0957
1.5972	0.8549	1.2000	1.2000	1.2000	1.2000	1.2000	0.1191	0.1191	0.1191	0.1191	0.1191
1.6219	0.9993	1.2000	1.2000	1.2000	1.2000	1.2000	0.0403	0.0403	0.0403	0.0403	0.0403
1.6219	0.9993	1.2000	1.2000	1.2000	1.2000	1.2000	0.0403	0.0403	0.0403	0.0403	0.0403
1.6230	1.0349	1.2000	1.2000	1.2000	1.2000	1.2000	0.0272	0.0272	0.0272	0.0272	0.0272
1.6794	1.5659	1.2000	1.2000	1.2000	1.2000	1.2000	0.1339	0.1339	0.1339	0.1339	0.1339
1.7244	1.6254	1.2000	1.2000	1.2000	1.2000	1.2000	0.1809	0.1809	0.1809	0.1809	0.1809
1.7438	1.0596	1.2000	1.2000	1.2000	1.2000	1.2000	0.0197	0.0197	0.0197	0.0197	0.0197
1.7454	0.9777	1.2000	1.2000	1.2000	1.2000	1.2000	0.0494	0.0494	0.0494	0.0494	0.0494
1.7695	0.8042	1.2000	1.2000	1.2000	1.2000	1.2000	0.1566	0.1566	0.1566	0.1566	0.1566
1.7717	1.2342	1.2000	1.2000	1.2000	1.2000	1.2000	0.0012	0.0012	0.0012	0.0012	0.0012
1.8056	0.7087	1.2000	1.2000	1.2000	1.2000	1.2000	0.2414	0.2414	0.2414	0.2414	0.2414
1.8959	0.9758	1.2000	1.2000	1.2000	1.2000	1.2000	0.0503	0.0503	0.0503	0.0503	0.0503
1.9362	1.2097	1.2000	1.2000	1.2000	1.2000	1.2000	0.0001	0.0001	0.0001	0.0001	0.0001
1.9581	1.1663	1.2000	1.2000	1.2000	1.2000	1.2000	0.0011	0.0011	0.0011	0.0011	0.0011
1.9584	0.8300	1.2000	1.2000	1.2000	1.2000	1.2000	0.1369	0.1369	0.1369	0.1369	0.1369
							27.2242	22.2512	17.5657	14.1867	16.0534

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 1000mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2118	0.3204	0.0000	0.0000	0.0000	0.0000	0.0000	0.1026	0.1026	0.1026	0.1026	0.1026
0.2118	0.3204	0.0000	0.0000	0.0000	0.0000	0.0000	0.1026	0.1026	0.1026	0.1026	0.1026
0.2269	0.3220	0.0000	0.0000	0.0000	0.0000	0.0000	0.1037	0.1037	0.1037	0.1037	0.1037
0.2269	0.3220	0.0000	0.0000	0.0000	0.0000	0.0000	0.1037	0.1037	0.1037	0.1037	0.1037
0.2497	0.5678	0.0000	0.0000	0.0000	0.0000	0.0000	0.3223	0.3223	0.3223	0.3223	0.3223
0.2497	0.5678	0.0000	0.0000	0.0000	0.0000	0.0000	0.3223	0.3223	0.3223	0.3223	0.3223
0.2899	0.4391	0.0000	0.0000	0.0000	0.0000	0.0000	0.1928	0.1928	0.1928	0.1928	0.1928
0.2899	0.4391	0.0000	0.0000	0.0000	0.0000	0.0000	0.1928	0.1928	0.1928	0.1928	0.1928
0.2986	0.4188	0.0000	0.0000	0.0000	0.0000	0.0000	0.1754	0.1754	0.1754	0.1754	0.1754
0.3045	0.1840	0.0212	0.0170	0.0141	0.0121	0.0108	0.0265	0.0279	0.0288	0.0295	0.0300
0.3113	0.4676	0.0532	0.0426	0.0355	0.0304	0.0271	0.1717	0.1806	0.1867	0.1911	0.1940
0.3113	0.4676	0.0532	0.0426	0.0355	0.0304	0.0271	0.1717	0.1806	0.1867	0.1911	0.1940
0.3143	0.4566	0.0674	0.0539	0.0449	0.0385	0.0343	0.1515	0.1622	0.1695	0.1748	0.1783
0.3154	0.5086	0.0725	0.0580	0.0484	0.0415	0.0370	0.1901	0.2030	0.2118	0.2182	0.2224
0.3222	0.3930	0.1045	0.0836	0.0697	0.0598	0.0533	0.0833	0.0957	0.1045	0.1111	0.1154
0.3363	0.2678	0.1705	0.1366	0.1139	0.0976	0.0871	0.0095	0.0172	0.0237	0.0289	0.0326
0.3643	0.6988	0.2998	0.2408	0.2011	0.1725	0.1543	0.1592	0.2098	0.2478	0.2770	0.2965
0.3643	0.6988	0.2998	0.2408	0.2011	0.1725	0.1543	0.1592	0.2098	0.2478	0.2770	0.2965
0.3648	0.4672	0.3021	0.2426	0.2026	0.1739	0.1555	0.0273	0.0504	0.0700	0.0860	0.0972
0.3845	0.5564	0.3909	0.3148	0.2633	0.2262	0.2028	0.0274	0.0583	0.0859	0.1090	0.1250
0.3930	0.7039	0.4286	0.3456	0.2893	0.2486	0.2232	0.0758	0.1283	0.1719	0.2073	0.2311
0.3930	0.7039	0.4286	0.3456	0.2893	0.2486	0.2232	0.0758	0.1283	0.1719	0.2073	0.2311
0.3947	0.7589	0.4360	0.3518	0.2945	0.2531	0.2273	0.1042	0.1657	0.2157	0.2558	0.2826
0.3947	0.7589	0.4360	0.3518	0.2945	0.2531	0.2273	0.1042	0.1657	0.2157	0.2558	0.2826
0.3951	0.7649	0.4378	0.3532	0.2957	0.2541	0.2282	0.1070	0.1695	0.2202	0.2609	0.2880
0.3973	0.8268	0.4474	0.3611	0.3024	0.2599	0.2335	0.1439	0.2169	0.2751	0.3214	0.3520
0.3973	0.8268	0.4474	0.3611	0.3024	0.2599	0.2335	0.1439	0.2169	0.2751	0.3214	0.3520
0.4064	0.3418	0.4869	0.3937	0.3300	0.2838	0.2554	0.0211	0.0027	0.0001	0.0034	0.0075
0.4065	0.9653	0.4874	0.3940	0.3303	0.2841	0.2556	0.2284	0.3263	0.4032	0.4640	0.5036
0.4065	0.6250	0.4874	0.3940	0.3303	0.2841	0.2556	0.0189	0.0533	0.0868	0.1162	0.1364
0.4163	0.9652	0.5292	0.4288	0.3597	0.3096	0.2791	0.1901	0.2878	0.3666	0.4298	0.4707
0.4316	0.5366	0.5929	0.4821	0.4053	0.3492	0.3158	0.0032	0.0030	0.0172	0.0351	0.0487
0.4316	0.5366	0.5929	0.4821	0.4053	0.3492	0.3158	0.0032	0.0030	0.0172	0.0351	0.0487
0.4340	0.6763	0.6027	0.4904	0.4124	0.3554	0.3216	0.0054	0.0346	0.0697	0.1030	0.1258
0.4340	0.6763	0.6027	0.4904	0.4124	0.3554	0.3216	0.0054	0.0346	0.0697	0.1030	0.1258
0.4463	0.5106	0.6521	0.5323	0.4485	0.3869	0.3511	0.0200	0.0005	0.0039	0.0153	0.0254
0.4539	0.5948	0.6819	0.5578	0.4705	0.4062	0.3694	0.0076	0.0014	0.0154	0.0356	0.0508
0.4539	0.5948	0.6819	0.5578	0.4705	0.4062	0.3694	0.0076	0.0014	0.0154	0.0356	0.0508
0.4552	0.6942	0.6869	0.5622	0.4743	0.4095	0.3725	0.0001	0.0174	0.0484	0.0810	0.1035
0.4552	0.6942	0.6869	0.5622	0.4743	0.4095	0.3725	0.0001	0.0174	0.0484	0.0810	0.1035
0.4555	0.8377	0.6881	0.5632	0.4751	0.4103	0.3732	0.0224	0.0754	0.1315	0.1827	0.2158
0.4609	0.8671	0.7088	0.5811	0.4907	0.4239	0.3862	0.0251	0.0818	0.1417	0.1964	0.2313
0.4639	0.8536	0.7201	0.5909	0.4993	0.4315	0.3934	0.0178	0.0690	0.1256	0.1782	0.2118
0.4678	0.9714	0.7347	0.6037	0.5104	0.4412	0.4027	0.0560	0.1352	0.2125	0.2810	0.3233
0.4682	0.5706	0.7362	0.6050	0.5115	0.4423	0.4037	0.0274	0.0012	0.0035	0.0165	0.0279
0.4699	0.9042	0.7425	0.6105	0.5163	0.4465	0.4078	0.0261	0.0862	0.1504	0.2095	0.2464
0.4725	0.4799	0.7521	0.6189	0.5237	0.4530	0.4140	0.0741	0.0193	0.0019	0.0007	0.0043
0.4741	1.0438	0.7580	0.6241	0.5282	0.4570	0.4178	0.0817	0.1762	0.2659	0.3444	0.3919
0.4778	0.8160	0.7714	0.6360	0.5386	0.4662	0.4267	0.0020	0.0324	0.0770	0.1224	0.1516

0.4795	1.0606	0.7775	0.6414	0.5434	0.4704	0.4308	0.0801	0.1757	0.2675	0.3484	0.3967
0.4795	1.0606	0.7775	0.6414	0.5434	0.4704	0.4308	0.0801	0.1757	0.2675	0.3484	0.3967
0.4805	0.5494	0.7811	0.6446	0.5462	0.4729	0.4332	0.0537	0.0091	0.0000	0.0059	0.0135
0.4829	1.0324	0.7897	0.6522	0.5529	0.4788	0.4390	0.0589	0.1445	0.2299	0.3064	0.3521
0.4829	1.0324	0.7897	0.6522	0.5529	0.4788	0.4390	0.0589	0.1445	0.2299	0.3064	0.3521
0.4849	0.4628	0.7968	0.6585	0.5585	0.4837	0.4438	0.1115	0.0383	0.0092	0.0004	0.0004
0.4874	0.9054	0.8055	0.6664	0.5654	0.4899	0.4498	0.0100	0.0571	0.1156	0.1726	0.2076
0.4891	0.9739	0.8114	0.6717	0.5701	0.4941	0.4538	0.0264	0.0913	0.1630	0.2302	0.2704
0.4902	0.8500	0.8153	0.6751	0.5731	0.4968	0.4565	0.0012	0.0306	0.0766	0.1248	0.1548
0.4918	0.3992	0.8208	0.6801	0.5776	0.5007	0.4603	0.1777	0.0789	0.0318	0.0103	0.0037
0.4926	0.7444	0.8235	0.6826	0.5798	0.5026	0.4622	0.0063	0.0038	0.0271	0.0584	0.0796
0.4926	0.7444	0.8235	0.6826	0.5798	0.5026	0.4622	0.0063	0.0038	0.0271	0.0584	0.0796
0.4926	0.7444	0.8235	0.6826	0.5798	0.5026	0.4622	0.0063	0.0038	0.0271	0.0584	0.0796
0.4937	0.6186	0.8273	0.6860	0.5828	0.5053	0.4649	0.0436	0.0045	0.0013	0.0128	0.0236
0.4990	0.9809	0.8452	0.7023	0.5973	0.5182	0.4776	0.0184	0.0776	0.1471	0.2140	0.2533
0.4995	0.5355	0.8469	0.7038	0.5986	0.5194	0.4788	0.0970	0.0283	0.0040	0.0003	0.0032
0.5016	0.8427	0.8538	0.7102	0.6043	0.5245	0.4838	0.0001	0.0176	0.0568	0.1013	0.1288
0.5046	0.8167	0.8637	0.7193	0.6125	0.5318	0.4910	0.0022	0.0095	0.0417	0.0812	0.1060
0.5046	0.8167	0.8637	0.7193	0.6125	0.5318	0.4910	0.0022	0.0095	0.0417	0.0812	0.1060
0.5048	0.5999	0.8644	0.7199	0.6130	0.5323	0.4915	0.0699	0.0144	0.0002	0.0046	0.0118
0.5138	0.4901	0.8932	0.7468	0.6371	0.5539	0.5131	0.1625	0.0659	0.0216	0.0041	0.0005
0.5142	0.2676	0.8945	0.7479	0.6382	0.5548	0.5141	0.3930	0.2307	0.1374	0.0825	0.0608
0.5179	1.1432	0.9060	0.7588	0.6480	0.5637	0.5230	0.0562	0.1477	0.2452	0.3358	0.3847
0.5189	0.5321	0.9091	0.7617	0.6507	0.5660	0.5254	0.1422	0.0527	0.0141	0.0012	0.0000
0.5227	0.2071	0.9207	0.7727	0.6607	0.5750	0.5345	0.5092	0.3199	0.2057	0.1353	0.1071
0.5301	1.1962	0.9427	0.7939	0.6799	0.5924	0.5522	0.0643	0.1619	0.2666	0.3646	0.4147
0.5334	0.8867	0.9522	0.8031	0.6885	0.6002	0.5602	0.0043	0.0070	0.0393	0.0821	0.1066
0.5403	0.4854	0.9717	0.8223	0.7061	0.6162	0.5767	0.2364	0.1135	0.0487	0.0171	0.0083
0.5427	0.4526	0.9782	0.8288	0.7122	0.6217	0.5825	0.2763	0.1415	0.0674	0.0286	0.0169
0.5487	0.0831	0.9943	0.8451	0.7273	0.6355	0.5969	0.8304	0.5806	0.4150	0.3051	0.2640
0.5502	0.7795	0.9983	0.8491	0.7310	0.6389	0.6005	0.0479	0.0048	0.0024	0.0198	0.0320
0.5540	0.6917	1.0081	0.8591	0.7404	0.6475	0.6096	0.1001	0.0280	0.0024	0.0020	0.0067
0.5562	0.5384	1.0137	0.8649	0.7459	0.6525	0.6149	0.2259	0.1066	0.0430	0.0130	0.0058
0.5606	0.4219	1.0246	0.8763	0.7566	0.6624	0.6254	0.3633	0.2065	0.1121	0.0579	0.0414
0.5622	0.4790	1.0285	0.8804	0.7605	0.6660	0.6293	0.3021	0.1612	0.0793	0.0350	0.0226
0.5632	0.7800	1.0310	0.8830	0.7630	0.6683	0.6317	0.0630	0.0106	0.0003	0.0125	0.0220
0.5632	0.7800	1.0310	0.8830	0.7630	0.6683	0.6317	0.0630	0.0106	0.0003	0.0125	0.0220
0.5661	0.8803	1.0379	0.8903	0.7700	0.6747	0.6386	0.0248	0.0001	0.0122	0.0422	0.0584
0.5671	0.3626	1.0402	0.8929	0.7724	0.6769	0.6410	0.4592	0.2812	0.1679	0.0988	0.0775
0.5730	0.8985	1.0538	0.9076	0.7865	0.6900	0.6552	0.0241	0.0001	0.0125	0.0435	0.0592
0.5730	0.8985	1.0538	0.9076	0.7865	0.6900	0.6552	0.0241	0.0001	0.0125	0.0435	0.0592
0.5761	0.6039	1.0607	0.9152	0.7938	0.6968	0.6626	0.2087	0.0969	0.0361	0.0086	0.0035
0.5761	0.6039	1.0607	0.9152	0.7938	0.6968	0.6626	0.2087	0.0969	0.0361	0.0086	0.0035
0.5762	0.8610	1.0610	0.9154	0.7940	0.6970	0.6629	0.0400	0.0030	0.0045	0.0269	0.0393
0.5808	0.9289	1.0709	0.9265	0.8048	0.7071	0.6739	0.0202	0.0000	0.0154	0.0492	0.0650
0.5811	0.6503	1.0716	0.9273	0.8055	0.7077	0.6746	0.1775	0.0767	0.0241	0.0033	0.0006
0.5811	0.6503	1.0716	0.9273	0.8055	0.7077	0.6746	0.1775	0.0767	0.0241	0.0033	0.0006
0.5899	0.3765	1.0896	0.9480	0.8258	0.7267	0.6958	0.5085	0.3266	0.2019	0.1227	0.1019
0.5918	0.7755	1.0933	0.9523	0.8301	0.7308	0.7003	0.1010	0.0313	0.0030	0.0020	0.0057
0.5945	0.8686	1.0985	0.9585	0.8362	0.7366	0.7068	0.0528	0.0081	0.0010	0.0174	0.0262
0.5949	0.4944	1.0992	0.9594	0.8371	0.7374	0.7078	0.3658	0.2162	0.1174	0.0590	0.0455
0.5961	0.8130	1.1015	0.9621	0.8398	0.7399	0.7106	0.0832	0.0222	0.0007	0.0053	0.0105
0.6051	1.1552	1.1176	0.9820	0.8598	0.7589	0.7322	0.0014	0.0300	0.0873	0.1571	0.1789
0.6176	0.3714	1.1377	1.0083	0.8867	0.7846	0.7622	0.5873	0.4057	0.2656	0.1708	0.1528
0.6260	0.2748	1.1497	1.0251	0.9043	0.8016	0.7824	0.7654	0.5630	0.3962	0.2775	0.2577
0.6361	1.3608	1.1624	1.0444	0.9248	0.8217	0.8066	0.0394	0.1001	0.1901	0.2907	0.3071
0.6390	0.4307	1.1657	1.0497	0.9306	0.8273	0.8136	0.5403	0.3832	0.2499	0.1573	0.1466

0.6454	0.5380	1.1725	1.0612	0.9432	0.8397	0.8290	0.4026	0.2738	0.1642	0.0910	0.0847
0.6460	0.5994	1.1731	1.0623	0.9443	0.8409	0.8304	0.3291	0.2142	0.1189	0.0583	0.0533
0.6460	0.5994	1.1731	1.0623	0.9443	0.8409	0.8304	0.3291	0.2142	0.1189	0.0583	0.0533
0.6568	1.3513	1.1828	1.0806	0.9649	0.8614	0.8563	0.0284	0.0733	0.1493	0.2400	0.2450
0.6598	0.9035	1.1851	1.0855	0.9705	0.8670	0.8635	0.0793	0.0331	0.0045	0.0013	0.0016
0.6598	0.9035	1.1851	1.0855	0.9705	0.8670	0.8635	0.0793	0.0331	0.0045	0.0013	0.0016
0.6669	0.6436	1.1899	1.0966	0.9834	0.8801	0.8806	0.2984	0.2052	0.1155	0.0559	0.0562
0.6697	0.9913	1.1915	1.1009	0.9884	0.8852	0.8873	0.0401	0.0120	0.0000	0.0113	0.0108
0.6736	0.7782	1.1936	1.1066	0.9953	0.8923	0.8966	0.1725	0.1078	0.0471	0.0130	0.0140
0.6798	1.1521	1.1962	1.1155	1.0061	0.9033	0.9115	0.0019	0.0013	0.0213	0.0619	0.0579
0.6846	0.9613	1.1978	1.1220	1.0142	0.9118	0.9230	0.0559	0.0258	0.0028	0.0025	0.0015
0.6846	0.9613	1.1978	1.1220	1.0142	0.9118	0.9230	0.0559	0.0258	0.0028	0.0025	0.0015
0.6891	0.8553	1.1989	1.1279	1.0217	0.9196	0.9338	0.1181	0.0743	0.0277	0.0041	0.0062
0.7039	0.7118	1.2000	1.1457	1.0453	0.9447	0.9694	0.2384	0.1883	0.1113	0.0543	0.0664
0.7313	0.8519	1.2000	1.1722	1.0849	0.9884	1.0351	0.1212	0.1026	0.0543	0.0186	0.0336
0.7368	0.7542	1.2000	1.1764	1.0921	0.9967	1.0483	0.1987	0.1783	0.1142	0.0588	0.0865
0.7473	0.9463	1.2000	1.1836	1.1054	1.0122	1.0735	0.0644	0.0563	0.0253	0.0043	0.0162
0.7681	0.8249	1.2000	1.1940	1.1292	1.0412	1.1234	0.1407	0.1362	0.0926	0.0468	0.0891
0.7771	0.9577	1.2000	1.1969	1.1384	1.0530	1.1450	0.0587	0.0572	0.0326	0.0091	0.0351
0.7935	1.0774	1.2000	1.1997	1.1537	1.0735	1.1844	0.0150	0.0150	0.0058	0.0000	0.0114
0.8227	0.7509	1.2000	1.2000	1.1755	1.1063	1.2000	0.2017	0.2017	0.1803	0.1263	0.2017
0.8388	0.8066	1.2000	1.2000	1.1846	1.1223	1.2000	0.1547	0.1547	0.1429	0.0997	0.1547
0.8485	0.6363	1.2000	1.2000	1.1891	1.1313	1.2000	0.3178	0.3178	0.3056	0.2451	0.3178
0.8587	0.9038	1.2000	1.2000	1.1930	1.1402	1.2000	0.0877	0.0877	0.0836	0.0559	0.0877
0.8596	1.2230	1.2000	1.2000	1.1933	1.1409	1.2000	0.0005	0.0005	0.0009	0.0067	0.0005
0.8826	0.6501	1.2000	1.2000	1.1988	1.1586	1.2000	0.3024	0.3024	0.3011	0.2586	0.3024
0.8991	0.8980	1.2000	1.2000	1.2000	1.1694	1.2000	0.0912	0.0912	0.0912	0.0737	0.0912
0.9384	1.0325	1.2000	1.2000	1.2000	1.1886	1.2000	0.0280	0.0280	0.0280	0.0243	0.0280
0.9456	1.3016	1.2000	1.2000	1.2000	1.1911	1.2000	0.0103	0.0103	0.0103	0.0122	0.0103
0.9537	1.1164	1.2000	1.2000	1.2000	1.1935	1.2000	0.0070	0.0070	0.0070	0.0059	0.0070
0.9647	0.8066	1.2000	1.2000	1.2000	1.1962	1.2000	0.1547	0.1547	0.1547	0.1518	0.1547
1.0430	1.4370	1.2000	1.2000	1.2000	1.2000	1.2000	0.0562	0.0562	0.0562	0.0562	0.0562
1.0852	1.2970	1.2000	1.2000	1.2000	1.2000	1.2000	0.0094	0.0094	0.0094	0.0094	0.0094
1.1543	0.9019	1.2000	1.2000	1.2000	1.2000	1.2000	0.0888	0.0888	0.0888	0.0888	0.0888
1.1752	1.2411	1.2000	1.2000	1.2000	1.2000	1.2000	0.0017	0.0017	0.0017	0.0017	0.0017
1.1765	0.9657	1.2000	1.2000	1.2000	1.2000	1.2000	0.0549	0.0549	0.0549	0.0549	0.0549
1.1790	0.9693	1.2000	1.2000	1.2000	1.2000	1.2000	0.0532	0.0532	0.0532	0.0532	0.0532
1.2172	0.7318	1.2000	1.2000	1.2000	1.2000	1.2000	0.2192	0.2192	0.2192	0.2192	0.2192
1.2179	1.3365	1.2000	1.2000	1.2000	1.2000	1.2000	0.0186	0.0186	0.0186	0.0186	0.0186
1.2288	0.9680	1.2000	1.2000	1.2000	1.2000	1.2000	0.0538	0.0538	0.0538	0.0538	0.0538
1.2306	1.2429	1.2000	1.2000	1.2000	1.2000	1.2000	0.0018	0.0018	0.0018	0.0018	0.0018
1.2412	0.9942	1.2000	1.2000	1.2000	1.2000	1.2000	0.0424	0.0424	0.0424	0.0424	0.0424
1.2412	0.9942	1.2000	1.2000	1.2000	1.2000	1.2000	0.0424	0.0424	0.0424	0.0424	0.0424
1.2511	0.9093	1.2000	1.2000	1.2000	1.2000	1.2000	0.0845	0.0845	0.0845	0.0845	0.0845
1.2603	1.3056	1.2000	1.2000	1.2000	1.2000	1.2000	0.0111	0.0111	0.0111	0.0111	0.0111
1.2629	1.2135	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.2672	0.8158	1.2000	1.2000	1.2000	1.2000	1.2000	0.1476	0.1476	0.1476	0.1476	0.1476
1.2698	1.2991	1.2000	1.2000	1.2000	1.2000	1.2000	0.0098	0.0098	0.0098	0.0098	0.0098
1.2714	1.1625	1.2000	1.2000	1.2000	1.2000	1.2000	0.0014	0.0014	0.0014	0.0014	0.0014
1.2975	0.9529	1.2000	1.2000	1.2000	1.2000	1.2000	0.0610	0.0610	0.0610	0.0610	0.0610
1.3556	1.2909	1.2000	1.2000	1.2000	1.2000	1.2000	0.0083	0.0083	0.0083	0.0083	0.0083
1.3590	1.1915	1.2000	1.2000	1.2000	1.2000	1.2000	0.0001	0.0001	0.0001	0.0001	0.0001
1.3860	1.4920	1.2000	1.2000	1.2000	1.2000	1.2000	0.0853	0.0853	0.0853	0.0853	0.0853
1.4302	1.2621	1.2000	1.2000	1.2000	1.2000	1.2000	0.0039	0.0039	0.0039	0.0039	0.0039
1.4322	1.4136	1.2000	1.2000	1.2000	1.2000	1.2000	0.0456	0.0456	0.0456	0.0456	0.0456
1.4424	0.8870	1.2000	1.2000	1.2000	1.2000	1.2000	0.0980	0.0980	0.0980	0.0980	0.0980
1.4424	0.8870	1.2000	1.2000	1.2000	1.2000	1.2000	0.0980	0.0980	0.0980	0.0980	0.0980

19.0363	16.5334	16.1397	16.9837	18.7401

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 1150mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2974	0.7339	0.0000	0.0000	0.0000	0.0000	0.0000	0.5386	0.5386	0.5386	0.5386	0.5386
0.2995	0.6726	0.0000	0.0000	0.0000	0.0000	0.0000	0.4524	0.4524	0.4524	0.4524	0.4524
0.3246	0.5285	0.1157	0.0926	0.0772	0.0662	0.0590	0.1704	0.1900	0.2037	0.2137	0.2204
0.3427	0.5042	0.2003	0.1605	0.1339	0.1148	0.1025	0.0924	0.1182	0.1372	0.1517	0.1614
0.3500	0.6346	0.2341	0.1877	0.1566	0.1344	0.1200	0.1604	0.1997	0.2284	0.2502	0.2648
0.3619	0.5663	0.2888	0.2319	0.1936	0.1661	0.1486	0.0770	0.1118	0.1389	0.1601	0.1745
0.3723	0.2032	0.3361	0.2702	0.2258	0.1938	0.1735	0.0177	0.0045	0.0005	0.0001	0.0009
0.3790	0.5152	0.3663	0.2948	0.2464	0.2116	0.1896	0.0221	0.0486	0.0722	0.0921	0.1060
0.4011	0.6781	0.4640	0.3748	0.3139	0.2699	0.2426	0.0458	0.0920	0.1326	0.1666	0.1896
0.4040	0.7801	0.4766	0.3851	0.3227	0.2775	0.2496	0.0921	0.1560	0.2092	0.2526	0.2815
0.4040	0.7801	0.4766	0.3851	0.3227	0.2775	0.2496	0.0921	0.1560	0.2092	0.2526	0.2815
0.4223	0.4937	0.5544	0.4498	0.3777	0.3252	0.2935	0.0037	0.0019	0.0135	0.0284	0.0401
0.4320	1.2695	0.5946	0.4835	0.4065	0.3503	0.3168	0.4555	0.6178	0.7447	0.8449	0.9076
0.4450	0.8586	0.6470	0.5279	0.4447	0.3836	0.3480	0.0448	0.1093	0.1713	0.2256	0.2607
0.4527	0.4963	0.6772	0.5538	0.4670	0.4032	0.3665	0.0327	0.0033	0.0009	0.0087	0.0169
0.4589	0.6462	0.7011	0.5745	0.4849	0.4189	0.3814	0.0030	0.0051	0.0260	0.0517	0.0701
0.4657	0.7933	0.7269	0.5968	0.5044	0.4360	0.3977	0.0044	0.0386	0.0835	0.1277	0.1565
0.4657	0.7933	0.7269	0.5968	0.5044	0.4360	0.3977	0.0044	0.0386	0.0835	0.1277	0.1565
0.4707	0.7521	0.7455	0.6131	0.5186	0.4485	0.4097	0.0000	0.0193	0.0545	0.0922	0.1173
0.4735	0.4406	0.7558	0.6222	0.5265	0.4555	0.4164	0.0993	0.0330	0.0074	0.0002	0.0006
0.4735	0.4406	0.7558	0.6222	0.5265	0.4555	0.4164	0.0993	0.0330	0.0074	0.0002	0.0006
0.4908	0.8042	0.8173	0.6770	0.5748	0.4982	0.4579	0.0002	0.0162	0.0526	0.0936	0.1199
0.4908	0.8042	0.8173	0.6770	0.5748	0.4982	0.4579	0.0002	0.0162	0.0526	0.0936	0.1199
0.5060	0.6585	0.8683	0.7235	0.6162	0.5352	0.4944	0.0440	0.0042	0.0018	0.0152	0.0269
0.5150	0.7503	0.8970	0.7503	0.6403	0.5568	0.5160	0.0215	0.0000	0.0121	0.0375	0.0549
0.5174	0.9410	0.9045	0.7573	0.6467	0.5625	0.5218	0.0013	0.0337	0.0866	0.1433	0.1757
0.5174	0.7936	0.9045	0.7573	0.6467	0.5625	0.5218	0.0123	0.0013	0.0216	0.0534	0.0739
0.5176	0.8707	0.9051	0.7579	0.6472	0.5629	0.5222	0.0012	0.0127	0.0499	0.0947	0.1214
0.5225	0.5981	0.9201	0.7721	0.6601	0.5746	0.5340	0.1037	0.0303	0.0039	0.0006	0.0041
0.5225	0.5981	0.9201	0.7721	0.6601	0.5746	0.5340	0.1037	0.0303	0.0039	0.0006	0.0041
0.5228	1.1010	0.9210	0.7730	0.6609	0.5753	0.5347	0.0324	0.1076	0.1937	0.2764	0.3207
0.5228	1.1010	0.9210	0.7730	0.6609	0.5753	0.5347	0.0324	0.1076	0.1937	0.2764	0.3207
0.5234	1.0094	0.9228	0.7747	0.6625	0.5767	0.5362	0.0075	0.0551	0.1203	0.1872	0.2239
0.5234	1.0094	0.9228	0.7747	0.6625	0.5767	0.5362	0.0075	0.0551	0.1203	0.1872	0.2239
0.5340	0.5074	0.9539	0.8048	0.6900	0.6016	0.5616	0.1994	0.0885	0.0333	0.0089	0.0029
0.5340	0.5074	0.9539	0.8048	0.6900	0.6016	0.5616	0.1994	0.0885	0.0333	0.0089	0.0029
0.5367	0.8303	0.9616	0.8123	0.6969	0.6078	0.5681	0.0172	0.0003	0.0178	0.0495	0.0688
0.5367	0.8303	0.9616	0.8123	0.6969	0.6078	0.5681	0.0172	0.0003	0.0178	0.0495	0.0688
0.5449	1.0374	0.9842	0.8348	0.7177	0.6268	0.5878	0.0028	0.0411	0.1022	0.1687	0.2022
0.5449	1.0374	0.9842	0.8348	0.7177	0.6268	0.5878	0.0028	0.0411	0.1022	0.1687	0.2022
0.5528	1.3043	1.0050	0.8560	0.7375	0.6448	0.6067	0.0896	0.2010	0.3213	0.4349	0.4866
0.5599	0.8351	1.0229	0.8745	0.7549	0.6609	0.6238	0.0353	0.0016	0.0064	0.0304	0.0447
0.5599	0.8351	1.0229	0.8745	0.7549	0.6609	0.6238	0.0353	0.0016	0.0064	0.0304	0.0447
0.5739	0.7351	1.0559	0.9098	0.7886	0.6920	0.6574	0.1029	0.0305	0.0029	0.0019	0.0060
0.5739	0.7351	1.0559	0.9098	0.7886	0.6920	0.6574	0.1029	0.0305	0.0029	0.0019	0.0060
0.6181	0.8667	1.1385	1.0093	0.8878	0.7857	0.7634	0.0738	0.0203	0.0004	0.0066	0.0107
0.6181	0.8667	1.1385	1.0093	0.8878	0.7857	0.7634	0.0738	0.0203	0.0004	0.0066	0.0107
0.6273	1.2117	1.1514	1.0277	0.9070	0.8042	0.7855	0.0036	0.0338	0.0928	0.1660	0.1816
0.6273	1.2117	1.1514	1.0277	0.9070	0.8042	0.7855	0.0036	0.0338	0.0928	0.1660	0.1816

0.6416	1.0470	1.1686	1.0545	0.9357	0.8324	0.8198	0.0148	0.0001	0.0124	0.0461	0.0516
0.6416	1.0470	1.1686	1.0545	0.9357	0.8324	0.8198	0.0148	0.0001	0.0124	0.0461	0.0516
0.6453	1.0345	1.1724	1.0610	0.9430	0.8395	0.8287	0.0190	0.0007	0.0084	0.0380	0.0423
0.6453	1.0345	1.1724	1.0610	0.9430	0.8395	0.8287	0.0190	0.0007	0.0084	0.0380	0.0423
0.6453	1.0345	1.1724	1.0610	0.9430	0.8395	0.8287	0.0190	0.0007	0.0084	0.0380	0.0423
0.6453	1.0345	1.1724	1.0610	0.9430	0.8395	0.8287	0.0190	0.0007	0.0084	0.0380	0.0423
0.6466	0.8346	1.1737	1.0633	0.9455	0.8420	0.8318	0.1150	0.0523	0.0123	0.0001	0.0000
0.6466	0.8346	1.1737	1.0633	0.9455	0.8420	0.8318	0.1150	0.0523	0.0123	0.0001	0.0000
0.6500	0.7586	1.1769	1.0692	0.9520	0.8485	0.8400	0.1750	0.0965	0.0374	0.0081	0.0066
0.6500	0.7586	1.1769	1.0692	0.9520	0.8485	0.8400	0.1750	0.0965	0.0374	0.0081	0.0066
0.7370	0.9921	1.2000	1.1766	1.0924	0.9970	1.0488	0.0432	0.0340	0.0101	0.0000	0.0032
0.7370	0.9921	1.2000	1.1766	1.0924	0.9970	1.0488	0.0432	0.0340	0.0101	0.0000	0.0032
0.7820	1.1593	1.2000	1.1981	1.1432	1.0593	1.1568	0.0017	0.0015	0.0003	0.0100	0.0000
0.8148	0.7866	1.2000	1.2000	1.1703	1.0979	1.2000	0.1709	0.1709	0.1472	0.0968	0.1709
0.8376	1.1708	1.2000	1.2000	1.1840	1.1212	1.2000	0.0009	0.0009	0.0002	0.0025	0.0009
0.8593	0.8406	1.2000	1.2000	1.1932	1.1407	1.2000	0.1292	0.1292	0.1243	0.0901	0.1292
0.8669	0.9319	1.2000	1.2000	1.1955	1.1469	1.2000	0.0719	0.0719	0.0695	0.0462	0.0719
0.8859	0.8108	1.2000	1.2000	1.1992	1.1609	1.2000	0.1515	0.1515	0.1508	0.1226	0.1515
0.8973	0.9812	1.2000	1.2000	1.2000	1.1683	1.2000	0.0479	0.0479	0.0479	0.0350	0.0479
0.8973	0.9812	1.2000	1.2000	1.2000	1.1683	1.2000	0.0479	0.0479	0.0479	0.0350	0.0479
0.9156	1.0225	1.2000	1.2000	1.2000	1.1785	1.2000	0.0315	0.0315	0.0315	0.0244	0.0315
0.9487	1.3010	1.2000	1.2000	1.2000	1.1921	1.2000	0.0102	0.0102	0.0102	0.0119	0.0102
0.9632	1.0081	1.2000	1.2000	1.2000	1.1959	1.2000	0.0368	0.0368	0.0368	0.0353	0.0368
0.9810	1.2605	1.2000	1.2000	1.2000	1.1989	1.2000	0.0037	0.0037	0.0037	0.0038	0.0037
0.9942	0.8779	1.2000	1.2000	1.2000	1.1999	1.2000	0.1037	0.1037	0.1037	0.1037	0.1037
1.0232	1.3215	1.2000	1.2000	1.2000	1.2000	1.2000	0.0148	0.0148	0.0148	0.0148	0.0148
1.0560	0.8092	1.2000	1.2000	1.2000	1.2000	1.2000	0.1527	0.1527	0.1527	0.1527	0.1527
1.0865	0.7006	1.2000	1.2000	1.2000	1.2000	1.2000	0.2494	0.2494	0.2494	0.2494	0.2494
1.1886	1.0329	1.2000	1.2000	1.2000	1.2000	1.2000	0.0279	0.0279	0.0279	0.0279	0.0279
1.2531	0.8878	1.2000	1.2000	1.2000	1.2000	1.2000	0.0975	0.0975	0.0975	0.0975	0.0975
1.2865	1.3268	1.2000	1.2000	1.2000	1.2000	1.2000	0.0161	0.0161	0.0161	0.0161	0.0161
1.2969	1.2520	1.2000	1.2000	1.2000	1.2000	1.2000	0.0027	0.0027	0.0027	0.0027	0.0027
1.3013	1.0378	1.2000	1.2000	1.2000	1.2000	1.2000	0.0263	0.0263	0.0263	0.0263	0.0263
1.3040	0.8864	1.2000	1.2000	1.2000	1.2000	1.2000	0.0984	0.0984	0.0984	0.0984	0.0984
1.3095	1.0968	1.2000	1.2000	1.2000	1.2000	1.2000	0.0107	0.0107	0.0107	0.0107	0.0107
1.3327	0.8271	1.2000	1.2000	1.2000	1.2000	1.2000	0.1391	0.1391	0.1391	0.1391	0.1391
1.3429	1.1697	1.2000	1.2000	1.2000	1.2000	1.2000	0.0009	0.0009	0.0009	0.0009	0.0009
1.4063	1.5294	1.2000	1.2000	1.2000	1.2000	1.2000	0.1085	0.1085	0.1085	0.1085	0.1085
1.4226	1.1102	1.2000	1.2000	1.2000	1.2000	1.2000	0.0081	0.0081	0.0081	0.0081	0.0081
1.4226	1.1102	1.2000	1.2000	1.2000	1.2000	1.2000	0.0081	0.0081	0.0081	0.0081	0.0081
1.4706	1.2446	1.2000	1.2000	1.2000	1.2000	1.2000	0.0020	0.0020	0.0020	0.0020	0.0020
0.8070	1.3910	1.2000	1.2000	1.2000	1.2000	1.2000	0.0365	0.0365	0.0365	0.0365	0.0365
0.9840	1.4560	1.2000	1.2000	1.2000	1.2000	1.2000	0.0655	0.0655	0.0655	0.0655	0.0655
1.2030	1.4020	1.2000	1.2000	1.2000	1.2000	1.2000	0.0408	0.0408	0.0408	0.0408	0.0408
							6.5215	6.3529	7.3192	8.7796	9.9129

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 1300mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.3427	0.5467	0.2003	0.1605	0.1339	0.1148	0.1025	0.1200	0.1492	0.1704	0.1865	0.1973
0.3500	0.7074	0.2341	0.1877	0.1566	0.1344	0.1200	0.2240	0.2701	0.3033	0.3284	0.3450
0.3619	0.5345	0.2888	0.2319	0.1936	0.1661	0.1486	0.0604	0.0916	0.1162	0.1357	0.1489
0.3623	1.1348	0.2907	0.2334	0.1949	0.1672	0.1495	0.7126	0.8126	0.8835	0.9362	0.9708
0.3651	0.5268	0.3034	0.2437	0.2035	0.1747	0.1562	0.0499	0.0801	0.1045	0.1240	0.1373
0.3764	0.5345	0.3546	0.2853	0.2384	0.2047	0.1834	0.0323	0.0621	0.0877	0.1088	0.1233
0.3808	1.2345	0.3744	0.3013	0.2520	0.2164	0.1939	0.7398	0.8708	0.9654	1.0366	1.0828
0.3827	0.7654	0.3829	0.3083	0.2578	0.2214	0.1985	0.1463	0.2090	0.2577	0.2959	0.3214
0.4320	0.3543	0.5946	0.4835	0.4065	0.3503	0.3168	0.0577	0.0167	0.0027	0.0000	0.0014
0.4450	0.9309	0.6470	0.5279	0.4447	0.3836	0.3480	0.0806	0.1624	0.2364	0.2995	0.3398
0.4735	0.6897	0.7558	0.6222	0.5265	0.4555	0.4164	0.0044	0.0046	0.0266	0.0549	0.0747
0.4908	0.7987	0.8173	0.6770	0.5748	0.4982	0.4579	0.0003	0.0148	0.0501	0.0903	0.1161
0.5008	0.8976	0.8512	0.7078	0.6022	0.5226	0.4819	0.0022	0.0360	0.0873	0.1406	0.1728
0.5012	0.1902	0.8525	0.7090	0.6033	0.5236	0.4829	0.4386	0.2691	0.1706	0.1111	0.0856
0.5340	0.5469	0.9539	0.8048	0.6900	0.6016	0.5616	0.1657	0.0665	0.0205	0.0030	0.0002
0.5367	0.8325	0.9616	0.8123	0.6969	0.6078	0.5681	0.0167	0.0004	0.0184	0.0505	0.0699
0.5371	0.4653	0.9627	0.8135	0.6980	0.6088	0.5690	0.2474	0.1212	0.0541	0.0206	0.0108
0.5403	0.5765	0.9717	0.8223	0.7061	0.6162	0.5767	0.1561	0.0604	0.0168	0.0016	0.0000
0.5470	1.0567	0.9898	0.8405	0.7230	0.6316	0.5928	0.0045	0.0467	0.1113	0.1807	0.2152
0.5556	0.5456	1.0122	0.8633	0.7444	0.6512	0.6134	0.2177	0.1009	0.0395	0.0111	0.0046
0.5739	0.7816	1.0559	0.9098	0.7886	0.6920	0.6574	0.0752	0.0164	0.0000	0.0080	0.0154
0.5779	0.9263	1.0647	0.9195	0.7980	0.7008	0.6670	0.0191	0.0000	0.0165	0.0509	0.0673
0.5889	0.7598	1.0876	0.9456	0.8235	0.7246	0.6934	0.1074	0.0345	0.0041	0.0012	0.0044
0.6159	0.4256	1.1351	1.0048	0.8831	0.7812	0.7582	0.5035	0.3355	0.2093	0.1264	0.1106
0.6181	0.8670	1.1385	1.0093	0.8878	0.7857	0.7634	0.0737	0.0203	0.0004	0.0066	0.0107
0.6184	0.7458	1.1389	1.0099	0.8884	0.7863	0.7642	0.1545	0.0698	0.0203	0.0016	0.0003
0.6210	1.1145	1.1427	1.0152	0.8939	0.7916	0.7704	0.0008	0.0099	0.0487	0.1043	0.1184
0.6217	0.6138	1.1437	1.0166	0.8953	0.7930	0.7721	0.2808	0.1623	0.0793	0.0321	0.0251
0.6338	0.9689	1.1597	1.0401	0.9202	0.8171	0.8011	0.0364	0.0051	0.0024	0.0230	0.0282
0.6376	0.7426	1.1642	1.0472	0.9278	0.8246	0.8102	0.1777	0.0928	0.0343	0.0067	0.0046
0.6393	0.8657	1.1661	1.0503	0.9312	0.8279	0.8143	0.0902	0.0341	0.0043	0.0014	0.0026
0.6452	1.4536	1.1723	1.0609	0.9428	0.8393	0.8285	0.0791	0.1542	0.2609	0.3773	0.3908
0.6453	1.0147	1.1724	1.0610	0.9430	0.8395	0.8287	0.0249	0.0021	0.0051	0.0307	0.0346
0.6466	0.8657	1.1737	1.0633	0.9455	0.8420	0.8318	0.0949	0.0391	0.0064	0.0006	0.0011
0.6701	0.8147	1.1917	1.1015	0.9891	0.8859	0.8882	0.1422	0.0822	0.0304	0.0051	0.0054
0.6776	0.4598	1.1954	1.1124	1.0023	0.8994	0.9062	0.5410	0.4258	0.2943	0.1933	0.1993
0.6988	0.9500	1.2000	1.1399	1.0373	0.9362	0.9571	0.0625	0.0360	0.0076	0.0002	0.0001
0.7042	0.8002	1.2000	1.1461	1.0458	0.9452	0.9701	0.1598	0.1196	0.0603	0.0210	0.0288
0.7279	0.8954	1.2000	1.1693	1.0802	0.9832	1.0270	0.0928	0.0750	0.0342	0.0077	0.0173
0.7319	1.1211	1.2000	1.1726	1.0857	0.9893	1.0366	0.0062	0.0027	0.0013	0.0174	0.0071
0.7324	0.5654	1.2000	1.1730	1.0863	0.9901	1.0378	0.4027	0.3692	0.2714	0.1803	0.2231
0.7368	1.3025	1.2000	1.1764	1.0921	0.9967	1.0483	0.0105	0.0159	0.0443	0.0935	0.0646
0.7773	1.4587	1.2000	1.1969	1.1386	1.0532	1.1455	0.0669	0.0685	0.1025	0.1644	0.0981
0.8051	0.8712	1.2000	1.2000	1.1632	1.0871	1.2000	0.1081	0.1081	0.0853	0.0466	0.1081
0.8124	0.8956	1.2000	1.2000	1.1686	1.0952	1.2000	0.0926	0.0926	0.0745	0.0398	0.0926
0.8529	0.7915	1.2000	1.2000	1.1909	1.1352	1.2000	0.1668	0.1668	0.1595	0.1181	0.1668
0.8841	0.6589	1.2000	1.2000	1.1990	1.1596	1.2000	0.2928	0.2928	0.2917	0.2507	0.2928
0.8973	0.9865	1.2000	1.2000	1.2000	1.1683	1.2000	0.0456	0.0456	0.0456	0.0330	0.0456
0.9156	1.0258	1.2000	1.2000	1.2000	1.1785	1.2000	0.0303	0.0303	0.0303	0.0233	0.0303

1.0573	1.2141	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.0705	1.2735	1.2000	1.2000	1.2000	1.2000	1.2000	0.0054	0.0054	0.0054	0.0054	0.0054
1.1886	1.0356	1.2000	1.2000	1.2000	1.2000	1.2000	0.0270	0.0270	0.0270	0.0270	0.0270
1.2148	1.4000	1.2000	1.2000	1.2000	1.2000	1.2000	0.0400	0.0400	0.0400	0.0400	0.0400
1.2531	0.8957	1.2000	1.2000	1.2000	1.2000	1.2000	0.0926	0.0926	0.0926	0.0926	0.0926
1.4063	1.5327	1.2000	1.2000	1.2000	1.2000	1.2000	0.1107	0.1107	0.1107	0.1107	0.1107
1.4226	1.1143	1.2000	1.2000	1.2000	1.2000	1.2000	0.0074	0.0074	0.0074	0.0074	0.0074
1.4235	1.4302	1.2000	1.2000	1.2000	1.2000	1.2000	0.0530	0.0530	0.0530	0.0530	0.0530
1.6545	1.3356	1.2000	1.2000	1.2000	1.2000	1.2000	0.0184	0.0184	0.0184	0.0184	0.0184
1.7001	1.4528	1.2000	1.2000	1.2000	1.2000	1.2000	0.0639	0.0639	0.0639	0.0639	0.0639
1.7717	1.3698	1.2000	1.2000	1.2000	1.2000	1.2000	0.0288	0.0288	0.0288	0.0288	0.0288
1.8056	0.9569	1.2000	1.2000	1.2000	1.2000	1.2000	0.0591	0.0591	0.0591	0.0591	0.0591
							7.9230	6.8591	6.4546	6.5879	7.1188

Variation of the Data to the best fit lines
- Doorway Experiment
- Door width 1500mm

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.3764	0.5624	0.3546	0.2853	0.2384	0.2047	0.1834	0.0432	0.0768	0.1050	0.1280	0.1437
0.3808	1.3120	0.3744	0.3013	0.2520	0.2164	0.1939	0.8792	1.0215	1.1238	1.2005	1.2502
0.3827	0.8240	0.3829	0.3083	0.2578	0.2214	0.1985	0.1945	0.2659	0.3206	0.3631	0.3912
0.3902	1.1738	0.4162	0.3355	0.2807	0.2412	0.2165	0.5740	0.7028	0.7976	0.8697	0.9165
0.4165	0.7211	0.5300	0.4295	0.3603	0.3101	0.2796	0.0365	0.0851	0.1302	0.1689	0.1949
0.4169	0.6425	0.5317	0.4309	0.3615	0.3112	0.2806	0.0123	0.0448	0.0789	0.1098	0.1310
0.4389	1.1231	0.6226	0.5072	0.4268	0.3680	0.3334	0.2505	0.3793	0.4848	0.5701	0.6236
0.4797	0.8617	0.7783	0.6420	0.5439	0.4709	0.4313	0.0070	0.0483	0.1010	0.1528	0.1853
0.4843	0.4768	0.7946	0.6566	0.5568	0.4823	0.4423	0.1010	0.0323	0.0064	0.0000	0.0012
0.4843	0.4768	0.7946	0.6566	0.5568	0.4823	0.4423	0.1010	0.0323	0.0064	0.0000	0.0012
0.5008	0.8888	0.8512	0.7078	0.6022	0.5226	0.4819	0.0014	0.0328	0.0822	0.1341	0.1656
0.5060	0.6823	0.8683	0.7235	0.6162	0.5352	0.4944	0.0346	0.0017	0.0044	0.0216	0.0353
0.5060	0.6823	0.8683	0.7235	0.6162	0.5352	0.4944	0.0346	0.0017	0.0044	0.0216	0.0353
0.5390	0.6748	0.9680	0.8187	0.7028	0.6132	0.5736	0.0860	0.0207	0.0008	0.0038	0.0102
0.5549	0.8941	1.0104	0.8615	0.7427	0.6496	0.6118	0.0135	0.0011	0.0229	0.0598	0.0797
0.5761	1.1211	1.0607	0.9152	0.7938	0.6968	0.6626	0.0036	0.0424	0.1071	0.1800	0.2102
0.5761	1.1457	1.0607	0.9152	0.7938	0.6968	0.6626	0.0072	0.0531	0.1238	0.2015	0.2333
0.5761	1.0827	1.0607	0.9152	0.7938	0.6968	0.6626	0.0005	0.0281	0.0835	0.1489	0.1765
0.5761	1.0827	1.0607	0.9152	0.7938	0.6968	0.6626	0.0005	0.0281	0.0835	0.1489	0.1765
0.5779	0.9253	1.0647	0.9195	0.7980	0.7008	0.6670	0.0194	0.0000	0.0162	0.0504	0.0667
0.5889	0.7804	1.0876	0.9456	0.8235	0.7246	0.6934	0.0944	0.0273	0.0019	0.0031	0.0076
0.5889	0.7804	1.0876	0.9456	0.8235	0.7246	0.6934	0.0944	0.0273	0.0019	0.0031	0.0076
0.5937	0.8074	1.0970	0.9567	0.8344	0.7348	0.7049	0.0838	0.0223	0.0007	0.0053	0.0105
0.5986	0.8015	1.1061	0.9677	0.8454	0.7452	0.7166	0.0928	0.0276	0.0019	0.0032	0.0072
0.5999	0.8345	1.1085	0.9706	0.8483	0.7480	0.7198	0.0751	0.0185	0.0002	0.0075	0.0132
0.6048	0.8011	1.1171	0.9813	0.8591	0.7582	0.7315	0.0998	0.0325	0.0034	0.0018	0.0048
0.6048	0.8011	1.1171	0.9813	0.8591	0.7582	0.7315	0.0998	0.0325	0.0034	0.0018	0.0048
0.6061	0.9611	1.1193	0.9842	0.8620	0.7610	0.7346	0.0251	0.0005	0.0098	0.0400	0.0513
0.6093	0.8077	1.1247	0.9910	0.8689	0.7676	0.7423	0.1005	0.0336	0.0038	0.0016	0.0043
0.6121	1.2351	1.1292	0.9969	0.8750	0.7734	0.7490	0.0112	0.0567	0.1297	0.2132	0.2363
0.6138	0.7025	1.1319	1.0005	0.8786	0.7769	0.7531	0.1844	0.0888	0.0310	0.0055	0.0026
0.6138	0.7025	1.1319	1.0005	0.8786	0.7769	0.7531	0.1844	0.0888	0.0310	0.0055	0.0026
0.6152	0.9089	1.1341	1.0034	0.8816	0.7797	0.7565	0.0507	0.0089	0.0007	0.0167	0.0232
0.6180	1.1272	1.1383	1.0091	0.8876	0.7855	0.7632	0.0001	0.0139	0.0574	0.1168	0.1325
0.6210	1.0872	1.1427	1.0152	0.8939	0.7916	0.7704	0.0031	0.0052	0.0374	0.0874	0.1004
0.6217	0.5769	1.1437	1.0166	0.8953	0.7930	0.7721	0.3213	0.1934	0.1014	0.0467	0.0381
0.6220	0.4989	1.1441	1.0172	0.8960	0.7936	0.7728	0.4164	0.2687	0.1577	0.0868	0.0750
0.6223	1.1679	1.1446	1.0178	0.8966	0.7942	0.7735	0.0005	0.0225	0.0736	0.1397	0.1555
0.6223	1.1679	1.1446	1.0178	0.8966	0.7942	0.7735	0.0005	0.0225	0.0736	0.1397	0.1555
0.6321	0.7891	1.1576	1.0369	0.9168	0.8138	0.7970	0.1358	0.0614	0.0163	0.0006	0.0001
0.6321	0.7891	1.1576	1.0369	0.9168	0.8138	0.7970	0.1358	0.0614	0.0163	0.0006	0.0001
0.6338	0.9321	1.1597	1.0401	0.9202	0.8171	0.8011	0.0518	0.0117	0.0001	0.0132	0.0172
0.6338	0.9321	1.1597	1.0401	0.9202	0.8171	0.8011	0.0518	0.0117	0.0001	0.0132	0.0172
0.6452	1.6813	1.1723	1.0609	0.9428	0.8393	0.8285	0.2591	0.3850	0.5455	0.7089	0.7273
0.6463	1.2404	1.1734	1.0628	0.9449	0.8415	0.8311	0.0045	0.0315	0.0873	0.1592	0.1675
0.6463	1.2404	1.1734	1.0628	0.9449	0.8415	0.8311	0.0045	0.0315	0.0873	0.1592	0.1675
0.6502	0.7663	1.1771	1.0695	0.9524	0.8489	0.8405	0.1688	0.0920	0.0346	0.0068	0.0055
0.6519	1.0281	1.1787	1.0724	0.9556	0.8521	0.8446	0.0227	0.0020	0.0052	0.0310	0.0337
0.6521	0.8746	1.1788	1.0728	0.9560	0.8525	0.8450	0.0925	0.0393	0.0066	0.0005	0.0009

0.6546	0.5321	1.1810	1.0770	0.9608	0.8572	0.8510	0.4210	0.2969	0.1837	0.1057	0.1017
0.6546	0.5321	1.1810	1.0770	0.9608	0.8572	0.8510	0.4210	0.2969	0.1837	0.1057	0.1017
0.6584	1.1109	1.1840	1.0832	0.9679	0.8644	0.8602	0.0054	0.0008	0.0205	0.0608	0.0629
0.6619	0.5353	1.1866	1.0888	0.9743	0.8709	0.8686	0.4242	0.3064	0.1928	0.1126	0.1111
0.6661	0.9088	1.1894	1.0954	0.9820	0.8786	0.8786	0.0788	0.0348	0.0054	0.0009	0.0009
0.6662	1.2262	1.1894	1.0955	0.9821	0.8788	0.8789	0.0014	0.0171	0.0596	0.1207	0.1207
0.6681	1.1047	1.1906	1.0984	0.9856	0.8823	0.8834	0.0074	0.0000	0.0142	0.0495	0.0490
0.6758	1.2252	1.1946	1.1098	0.9992	0.8962	0.9019	0.0009	0.0133	0.0511	0.1082	0.1045
0.6758	1.2252	1.1946	1.1098	0.9992	0.8962	0.9019	0.0009	0.0133	0.0511	0.1082	0.1045
0.6783	0.9941	1.1956	1.1134	1.0035	0.9007	0.9079	0.0406	0.0142	0.0001	0.0087	0.0074
0.6800	1.1124	1.1963	1.1157	1.0064	0.9037	0.9120	0.0070	0.0000	0.0112	0.0436	0.0402
0.6930	0.9406	1.1995	1.1328	1.0281	0.9263	0.9432	0.0671	0.0370	0.0076	0.0002	0.0000
0.6930	0.9406	1.1995	1.1328	1.0281	0.9263	0.9432	0.0671	0.0370	0.0076	0.0002	0.0000
0.6993	1.1929	1.2000	1.1404	1.0381	0.9370	0.9583	0.0001	0.0027	0.0239	0.0654	0.0550
0.6993	1.1929	1.2000	1.1404	1.0381	0.9370	0.9583	0.0001	0.0027	0.0239	0.0654	0.0550
0.7101	1.2267	1.2000	1.1525	1.0547	0.9549	0.9842	0.0007	0.0055	0.0296	0.0739	0.0588
0.7189	1.3009	1.2000	1.1613	1.0676	0.9691	1.0054	0.0102	0.0195	0.0544	0.1101	0.0873
0.7319	1.0903	1.2000	1.1726	1.0857	0.9893	1.0366	0.0120	0.0068	0.0000	0.0102	0.0029
0.7368	1.2837	1.2000	1.1764	1.0921	0.9967	1.0483	0.0070	0.0115	0.0367	0.0824	0.0554
0.7377	1.1506	1.2000	1.1771	1.0933	0.9981	1.0505	0.0024	0.0007	0.0033	0.0233	0.0100
0.7477	0.6844	1.2000	1.1838	1.1059	1.0128	1.0745	0.2658	0.2494	0.1776	0.1078	0.1521
0.7521	1.3547	1.2000	1.1864	1.1112	1.0191	1.0850	0.0239	0.0283	0.0593	0.1126	0.0727
0.7624	1.2753	1.2000	1.1916	1.1230	1.0334	1.1098	0.0057	0.0070	0.0232	0.0585	0.0274
0.7740	1.1514	1.2000	1.1960	1.1353	1.0490	1.1376	0.0024	0.0020	0.0003	0.0105	0.0002
0.7741	1.1526	1.2000	1.1960	1.1354	1.0491	1.1378	0.0022	0.0019	0.0003	0.0107	0.0002
0.7741	1.1526	1.2000	1.1960	1.1354	1.0491	1.1378	0.0022	0.0019	0.0003	0.0107	0.0002
0.7741	1.1526	1.2000	1.1960	1.1354	1.0491	1.1378	0.0022	0.0019	0.0003	0.0107	0.0002
0.7741	1.1526	1.2000	1.1960	1.1354	1.0491	1.1378	0.0022	0.0019	0.0003	0.0107	0.0002
0.7773	1.4238	1.2000	1.1969	1.1386	1.0532	1.1455	0.0501	0.0514	0.0813	0.1373	0.0774
0.7773	1.4238	1.2000	1.1969	1.1386	1.0532	1.1455	0.0501	0.0514	0.0813	0.1373	0.0774
0.8051	0.7712	1.2000	1.2000	1.1632	1.0871	1.2000	0.1839	0.1839	0.1536	0.0998	0.1839
0.8051	0.7712	1.2000	1.2000	1.1632	1.0871	1.2000	0.1839	0.1839	0.1536	0.0998	0.1839
0.8318	1.6032	1.2000	1.2000	1.1809	1.1155	1.2000	0.1626	0.1626	0.1783	0.2378	0.1626
0.8318	1.6032	1.2000	1.2000	1.1809	1.1155	1.2000	0.1626	0.1626	0.1783	0.2378	0.1626
0.9201	1.5284	1.2000	1.2000	1.2000	1.1808	1.2000	0.1079	0.1079	0.1079	0.1209	0.1079
0.9526	1.0068	1.2000	1.2000	1.2000	1.1932	1.2000	0.0373	0.0373	0.0373	0.0347	0.0373
0.9541	1.2853	1.2000	1.2000	1.2000	1.1936	1.2000	0.0073	0.0073	0.0073	0.0084	0.0073
1.0154	1.4081	1.2000	1.2000	1.2000	1.2000	1.2000	0.0433	0.0433	0.0433	0.0433	0.0433
1.0260	1.2798	1.2000	1.2000	1.2000	1.2000	1.2000	0.0064	0.0064	0.0064	0.0064	0.0064
1.0548	1.1580	1.2000	1.2000	1.2000	1.2000	1.2000	0.0018	0.0018	0.0018	0.0018	0.0018
1.0573	1.1882	1.2000	1.2000	1.2000	1.2000	1.2000	0.0001	0.0001	0.0001	0.0001	0.0001
1.0705	1.2732	1.2000	1.2000	1.2000	1.2000	1.2000	0.0054	0.0054	0.0054	0.0054	0.0054
1.0958	1.5156	1.2000	1.2000	1.2000	1.2000	1.2000	0.0996	0.0996	0.0996	0.0996	0.0996
1.1103	1.4953	1.2000	1.2000	1.2000	1.2000	1.2000	0.0872	0.0872	0.0872	0.0872	0.0872
1.1803	1.0257	1.2000	1.2000	1.2000	1.2000	1.2000	0.0304	0.0304	0.0304	0.0304	0.0304
1.2726	1.2157	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.3328	1.5815	1.2000	1.2000	1.2000	1.2000	1.2000	0.1455	0.1455	0.1455	0.1455	0.1455
1.3625	1.2749	1.2000	1.2000	1.2000	1.2000	1.2000	0.0056	0.0056	0.0056	0.0056	0.0056
1.4034	1.1699	1.2000	1.2000	1.2000	1.2000	1.2000	0.0009	0.0009	0.0009	0.0009	0.0009
1.5454	1.5223	1.2000	1.2000	1.2000	1.2000	1.2000	0.1039	0.1039	0.1039	0.1039	0.1039
1.5454	1.5223	1.2000	1.2000	1.2000	1.2000	1.2000	0.1039	0.1039	0.1039	0.1039	0.1039
1.6545	1.3230	1.2000	1.2000	1.2000	1.2000	1.2000	0.0151	0.0151	0.0151	0.0151	0.0151
1.7001	1.4521	1.2000	1.2000	1.2000	1.2000	1.2000	0.0636	0.0636	0.0636	0.0636	0.0636
1.7193	1.1652	1.2000	1.2000	1.2000	1.2000	1.2000	0.0012	0.0012	0.0012	0.0012	0.0012
1.7246	1.3909	1.2000	1.2000	1.2000	1.2000	1.2000	0.0365	0.0365	0.0365	0.0365	0.0365
1.7976	1.2320	1.2000	1.2000	1.2000	1.2000	1.2000	0.0010	0.0010	0.0010	0.0010	0.0010
1.8232	1.3786	1.2000	1.2000	1.2000	1.2000	1.2000	0.0319	0.0319	0.0319	0.0319	0.0319

1.2830	0.8840	1.2000	1.2000	1.2000	1.2000	1.2000	0.0999	0.0999	0.0999	0.0999	0.0999
1.5910	0.9170	1.2000	1.2000	1.2000	1.2000	1.2000	0.0801	0.0801	0.0801	0.0801	0.0801
1.8070	1.1380	1.2000	1.2000	1.2000	1.2000	1.2000	0.0038	0.0038	0.0038	0.0038	0.0038
0.3890	0.3810	1.2000	1.2000	1.2000	1.2000	1.2000	0.6708	0.6708	0.6708	0.6708	0.6708
							9.7316	8.6155	9.0423	10.8920	11.2185

Variation of the Data to the best fit lines
- Corner Experiment

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.3190	0.5979	0.0895	0.0716	0.0597	0.0511	0.0456	0.2585	0.2770	0.2897	0.2989	0.3050
0.3454	0.7140	0.2128	0.1706	0.1423	0.1220	0.1090	0.2512	0.2953	0.3268	0.3504	0.3661
0.3532	0.7074	0.2489	0.1996	0.1666	0.1429	0.1277	0.2102	0.2578	0.2925	0.3186	0.3361
0.3677	0.8101	0.3153	0.2533	0.2116	0.1816	0.1625	0.2448	0.3100	0.3582	0.3950	0.4194
0.3860	0.5860	0.3976	0.3203	0.2679	0.2301	0.2064	0.0355	0.0706	0.1012	0.1267	0.1441
0.3989	0.7149	0.4544	0.3669	0.3072	0.2641	0.2374	0.0679	0.1212	0.1662	0.2032	0.2281
0.4054	0.6975	0.4826	0.3901	0.3269	0.2812	0.2530	0.0462	0.0945	0.1373	0.1733	0.1976
0.4134	1.0251	0.5169	0.4185	0.3510	0.3021	0.2722	0.2583	0.3680	0.4544	0.5228	0.5670
0.4162	0.8034	0.5288	0.4284	0.3594	0.3094	0.2789	0.0754	0.1407	0.1971	0.2441	0.2752
0.4162	0.7315	0.5288	0.4284	0.3594	0.3094	0.2789	0.0411	0.0919	0.1384	0.1782	0.2049
0.4248	1.1013	0.5648	0.4585	0.3851	0.3317	0.2995	0.2878	0.4132	0.5130	0.5924	0.6429
0.4401	1.0658	0.6274	0.5113	0.4303	0.3711	0.3362	0.1922	0.3075	0.4038	0.4827	0.5323
0.4426	0.9966	0.6374	0.5198	0.4377	0.3775	0.3422	0.1290	0.2274	0.3125	0.3834	0.4282
0.4471	0.6937	0.6553	0.5350	0.4508	0.3890	0.3530	0.0015	0.0252	0.0590	0.0929	0.1161
0.4512	0.7955	0.6714	0.5488	0.4627	0.3994	0.3629	0.0154	0.0609	0.1108	0.1569	0.1872
0.4514	0.7648	0.6722	0.5495	0.4633	0.3999	0.3634	0.0086	0.0464	0.0909	0.1332	0.1612
0.4527	0.5304	0.6772	0.5538	0.4670	0.4032	0.3665	0.0215	0.0005	0.0040	0.0162	0.0269
0.4556	0.7017	0.6885	0.5635	0.4754	0.4105	0.3734	0.0002	0.0191	0.0512	0.0848	0.1078
0.4619	0.4770	0.7126	0.5844	0.4935	0.4264	0.3886	0.0555	0.0115	0.0003	0.0026	0.0078
0.4732	0.9930	0.7547	0.6212	0.5257	0.4547	0.4157	0.0568	0.1382	0.2184	0.2897	0.3333
0.4812	0.4776	0.7836	0.6468	0.5481	0.4746	0.4349	0.0936	0.0286	0.0050	0.0000	0.0018
0.4838	0.8512	0.7929	0.6550	0.5554	0.4810	0.4411	0.0034	0.0385	0.0875	0.1370	0.1682
0.4838	0.8512	0.7929	0.6550	0.5554	0.4810	0.4411	0.0034	0.0385	0.0875	0.1370	0.1682
0.4975	0.7298	0.8402	0.6977	0.5932	0.5146	0.4740	0.0122	0.0010	0.0187	0.0463	0.0654
0.5005	0.3928	0.8502	0.7069	0.6014	0.5219	0.4812	0.2092	0.0986	0.0435	0.0167	0.0078
0.5044	0.7567	0.8631	0.7187	0.6119	0.5313	0.4906	0.0113	0.0014	0.0210	0.0508	0.0708
0.5094	0.5367	0.8793	0.7337	0.6254	0.5433	0.5026	0.1174	0.0388	0.0079	0.0000	0.0012
0.5241	0.6341	0.9249	0.7768	0.6643	0.5783	0.5378	0.0846	0.0204	0.0009	0.0031	0.0093
0.5257	1.0450	0.9297	0.7813	0.6685	0.5821	0.5417	0.0133	0.0695	0.1417	0.2142	0.2533
0.5354	0.5230	0.9579	0.8087	0.6936	0.6048	0.5650	0.1891	0.0816	0.0291	0.0067	0.0018
0.5445	1.0711	0.9831	0.8337	0.7167	0.6258	0.5868	0.0077	0.0563	0.1255	0.1982	0.2345
0.5498	0.5385	0.9972	0.8480	0.7300	0.6380	0.5995	0.2104	0.0958	0.0367	0.0099	0.0037
0.5648	1.1483	1.0348	0.8870	0.7668	0.6718	0.6355	0.0129	0.0682	0.1455	0.2270	0.2629
0.5712	0.5560	1.0497	0.9031	0.7822	0.6860	0.6509	0.2438	0.1205	0.0512	0.0169	0.0090
0.5741	0.6742	1.0563	0.9103	0.7891	0.6924	0.6578	0.1460	0.0557	0.0132	0.0003	0.0003
0.5988	0.4813	1.1065	0.9682	0.8459	0.7457	0.7171	0.3908	0.2370	0.1329	0.0699	0.0556
0.6049	0.7729	1.1173	0.9816	0.8593	0.7585	0.7318	0.1186	0.0435	0.0075	0.0002	0.0017
0.6200	0.6949	1.1413	1.0132	0.8918	0.7895	0.7680	0.1993	0.1013	0.0388	0.0090	0.0053
0.6260	0.6930	1.1497	1.0251	0.9043	0.8016	0.7824	0.2085	0.1103	0.0446	0.0118	0.0080
0.6850	1.1307	1.1979	1.1225	1.0149	0.9125	0.9240	0.0045	0.0001	0.0134	0.0476	0.0427
0.6971	0.9564	1.1999	1.1378	1.0346	0.9333	0.9530	0.0593	0.0329	0.0061	0.0005	0.0000
0.7174	1.3343	1.2000	1.1598	1.0655	0.9667	1.0018	0.0180	0.0304	0.0723	0.1352	0.1106
0.7418	1.0197	1.2000	1.1800	1.0985	1.0041	1.0603	0.0325	0.0257	0.0062	0.0002	0.0017
0.7526	1.1415	1.2000	1.1867	1.1118	1.0198	1.0862	0.0034	0.0020	0.0009	0.0148	0.0031
0.7550	0.9819	1.2000	1.1880	1.1146	1.0232	1.0920	0.0476	0.0425	0.0176	0.0017	0.0121
0.7627	1.2137	1.2000	1.1918	1.1233	1.0338	1.1105	0.0002	0.0005	0.0082	0.0323	0.0107
0.7698	1.2162	1.2000	1.1946	1.1310	1.0434	1.1275	0.0003	0.0005	0.0073	0.0298	0.0079
0.7799	1.3616	1.2000	1.1976	1.1412	1.0566	1.1518	0.0261	0.0269	0.0486	0.0930	0.0440
0.7884	1.1716	1.2000	1.1992	1.1491	1.0672	1.1722	0.0008	0.0008	0.0005	0.0109	0.0000

0.7960	1.4576	1.2000	1.1999	1.1558	1.0764	1.1904	0.0664	0.0664	0.0911	0.1453	0.0714
0.8297	1.0117	1.2000	1.2000	1.1797	1.1134	1.2000	0.0355	0.0355	0.0282	0.0104	0.0355
0.8334	1.4731	1.2000	1.2000	1.1818	1.1171	1.2000	0.0746	0.0746	0.0848	0.1267	0.0746
0.8371	1.1306	1.2000	1.2000	1.1838	1.1207	1.2000	0.0048	0.0048	0.0028	0.0001	0.0048
0.8391	1.3665	1.2000	1.2000	1.1848	1.1226	1.2000	0.0277	0.0277	0.0330	0.0595	0.0277
0.8433	1.1523	1.2000	1.2000	1.1868	1.1266	1.2000	0.0023	0.0023	0.0012	0.0007	0.0023
0.8491	0.9836	1.2000	1.2000	1.1894	1.1319	1.2000	0.0468	0.0468	0.0424	0.0220	0.0468
0.8606	0.9115	1.2000	1.2000	1.1936	1.1418	1.2000	0.0832	0.0832	0.0796	0.0530	0.0832
0.8624	0.9464	1.2000	1.2000	1.1942	1.1432	1.2000	0.0643	0.0643	0.0614	0.0388	0.0643
0.8656	1.0890	1.2000	1.2000	1.1951	1.1458	1.2000	0.0123	0.0123	0.0113	0.0032	0.0123
0.9422	1.5241	1.2000	1.2000	1.2000	1.1899	1.2000	0.1050	0.1050	0.1050	0.1117	0.1050
0.9798	1.1381	1.2000	1.2000	1.2000	1.1988	1.2000	0.0038	0.0038	0.0038	0.0037	0.0038
0.9885	1.0007	1.2000	1.2000	1.2000	1.1996	1.2000	0.0397	0.0397	0.0397	0.0396	0.0397
1.0152	1.0965	1.2000	1.2000	1.2000	1.2000	1.2000	0.0107	0.0107	0.0107	0.0107	0.0107
1.0169	1.1675	1.2000	1.2000	1.2000	1.2000	1.2000	0.0011	0.0011	0.0011	0.0011	0.0011
							5.3042	5.3231	6.0415	7.1935	7.7318

Variation of the Data to the best fit lines
- Main Flow in Opposed Flow
1 Person Opposing

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2191	0.6012	0.0000	0.0000	0.0000	0.0000	0.0000	0.3614	0.3614	0.3614	0.3614	0.3614
0.2614	0.3232	0.0000	0.0000	0.0000	0.0000	0.0000	0.1045	0.1045	0.1045	0.1045	0.1045
0.3123	0.2912	0.0579	0.0464	0.0386	0.0331	0.0295	0.0544	0.0599	0.0638	0.0666	0.0685
0.4067	0.6954	0.4882	0.3948	0.3309	0.2846	0.2561	0.0429	0.0904	0.1329	0.1688	0.1930
0.4118	0.5340	0.5101	0.4129	0.3462	0.2979	0.2683	0.0006	0.0147	0.0352	0.0557	0.0706
0.4657	0.7876	0.7269	0.5968	0.5044	0.4360	0.3977	0.0037	0.0364	0.0802	0.1237	0.1521
0.4789	0.8128	0.7754	0.6395	0.5417	0.4689	0.4294	0.0014	0.0300	0.0735	0.1183	0.1470
0.4789	0.8128	0.7754	0.6395	0.5417	0.4689	0.4294	0.0014	0.0300	0.0735	0.1183	0.1470
0.4932	0.9328	0.8256	0.6844	0.5814	0.5041	0.4637	0.0115	0.0617	0.1235	0.1838	0.2201
0.5083	0.8362	0.8757	0.7304	0.6224	0.5407	0.4999	0.0016	0.0112	0.0457	0.0873	0.1131
0.5228	1.2250	0.9210	0.7730	0.6609	0.5753	0.5347	0.0924	0.2043	0.3182	0.4222	0.4765
0.5291	0.5543	0.9397	0.7910	0.6774	0.5901	0.5498	0.1485	0.0560	0.0151	0.0013	0.0000
0.6054	1.2977	1.1181	0.9826	0.8604	0.7595	0.7330	0.0322	0.0992	0.1912	0.2896	0.3189
0.6335	0.4921	1.1593	1.0395	0.9196	0.8165	0.8004	0.4452	0.2997	0.1827	0.1052	0.0950
0.6374	1.3280	1.1639	1.0468	0.9274	0.8242	0.8098	0.0269	0.0790	0.1604	0.2538	0.2685
0.7088	1.0378	1.2000	1.1511	1.0528	0.9528	0.9811	0.0263	0.0128	0.0002	0.0072	0.0032
0.7416	0.8062	1.2000	1.1799	1.0983	1.0039	1.0598	0.1551	0.1396	0.0853	0.0391	0.0643
0.7908	1.2009	1.2000	1.1995	1.1513	1.0702	1.1779	0.0000	0.0000	0.0025	0.0171	0.0005
0.8227	0.8703	1.2000	1.2000	1.1755	1.1063	1.2000	0.1087	0.1087	0.0932	0.0557	0.1087
0.8236	0.8756	1.2000	1.2000	1.1761	1.1072	1.2000	0.1052	0.1052	0.0903	0.0536	0.1052
0.8345	0.6732	1.2000	1.2000	1.1824	1.1182	1.2000	0.2775	0.2775	0.2593	0.1980	0.2775
0.8631	1.3073	1.2000	1.2000	1.1944	1.1438	1.2000	0.0115	0.0115	0.0127	0.0267	0.0115
0.8723	0.9154	1.2000	1.2000	1.1968	1.1511	1.2000	0.0810	0.0810	0.0792	0.0555	0.0810
0.9116	1.1303	1.2000	1.2000	1.2000	1.1765	1.2000	0.0049	0.0049	0.0049	0.0021	0.0049
0.9128	1.1719	1.2000	1.2000	1.2000	1.1771	1.2000	0.0008	0.0008	0.0008	0.0000	0.0008
0.9333	0.9630	1.2000	1.2000	1.2000	1.1866	1.2000	0.0562	0.0562	0.0562	0.0500	0.0562
0.9485	1.4318	1.2000	1.2000	1.2000	1.1920	1.2000	0.0537	0.0537	0.0537	0.0575	0.0537
0.9734	1.0018	1.2000	1.2000	1.2000	1.1979	1.2000	0.0393	0.0393	0.0393	0.0385	0.0393
0.9761	1.0314	1.2000	1.2000	1.2000	1.1983	1.2000	0.0284	0.0284	0.0284	0.0278	0.0284
1.0467	0.5538	1.2000	1.2000	1.2000	1.2000	1.2000	0.4175	0.4175	0.4175	0.4175	0.4175
1.0516	1.6434	1.2000	1.2000	1.2000	1.2000	1.2000	0.1966	0.1966	0.1966	0.1966	0.1966
1.0526	1.0874	1.2000	1.2000	1.2000	1.2000	1.2000	0.0127	0.0127	0.0127	0.0127	0.0127
1.0714	0.7886	1.2000	1.2000	1.2000	1.2000	1.2000	0.1692	0.1692	0.1692	0.1692	0.1692
1.0999	1.6248	1.2000	1.2000	1.2000	1.2000	1.2000	0.1804	0.1804	0.1804	0.1804	0.1804
1.1045	1.4521	1.2000	1.2000	1.2000	1.2000	1.2000	0.0635	0.0635	0.0635	0.0635	0.0635
1.1048	1.4502	1.2000	1.2000	1.2000	1.2000	1.2000	0.0626	0.0626	0.0626	0.0626	0.0626
1.1073	0.8004	1.2000	1.2000	1.2000	1.2000	1.2000	0.1597	0.1597	0.1597	0.1597	0.1597
1.1185	1.1464	1.2000	1.2000	1.2000	1.2000	1.2000	0.0029	0.0029	0.0029	0.0029	0.0029
1.1284	1.0927	1.2000	1.2000	1.2000	1.2000	1.2000	0.0115	0.0115	0.0115	0.0115	0.0115
1.1386	1.3396	1.2000	1.2000	1.2000	1.2000	1.2000	0.0195	0.0195	0.0195	0.0195	0.0195
1.1443	0.9478	1.2000	1.2000	1.2000	1.2000	1.2000	0.0636	0.0636	0.0636	0.0636	0.0636
1.1501	0.8852	1.2000	1.2000	1.2000	1.2000	1.2000	0.0991	0.0991	0.0991	0.0991	0.0991
1.1649	1.3016	1.2000	1.2000	1.2000	1.2000	1.2000	0.0103	0.0103	0.0103	0.0103	0.0103
1.1742	1.4014	1.2000	1.2000	1.2000	1.2000	1.2000	0.0406	0.0406	0.0406	0.0406	0.0406
1.1804	1.4338	1.2000	1.2000	1.2000	1.2000	1.2000	0.0547	0.0547	0.0547	0.0547	0.0547
1.1871	1.2531	1.2000	1.2000	1.2000	1.2000	1.2000	0.0028	0.0028	0.0028	0.0028	0.0028
1.2436	1.5604	1.2000	1.2000	1.2000	1.2000	1.2000	0.1299	0.1299	0.1299	0.1299	0.1299
1.2569	1.4629	1.2000	1.2000	1.2000	1.2000	1.2000	0.0691	0.0691	0.0691	0.0691	0.0691
1.2950	1.4879	1.2000	1.2000	1.2000	1.2000	1.2000	0.0829	0.0829	0.0829	0.0829	0.0829

1.3419	1.4509	1.2000	1.2000	1.2000	1.2000	1.2000	0.0629	0.0629	0.0629	0.0629	0.0629
1.3692	0.9699	1.2000	1.2000	1.2000	1.2000	1.2000	0.0530	0.0530	0.0530	0.0530	0.0530
1.4714	0.8027	1.2000	1.2000	1.2000	1.2000	1.2000	0.1578	0.1578	0.1578	0.1578	0.1578
1.5051	1.6548	1.2000	1.2000	1.2000	1.2000	1.2000	0.2069	0.2069	0.2069	0.2069	0.2069
1.5621	1.1873	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.5621	1.1873	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.5621	1.1873	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
			Sum of the Differences Squared				4.6074	4.7884	5.0980	5.4194	5.9017

Variation of the Data to the best fit lines
- Main Flow in Opposed Flow
3 People Opposing

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.3180	0.1954	0.0848	0.0678	0.0565	0.0485	0.0432	0.0123	0.0163	0.0193	0.0216	0.0232
0.3203	0.7172	0.0956	0.0765	0.0637	0.0546	0.0487	0.3865	0.4106	0.4270	0.4390	0.4469
0.3595	0.6854	0.2778	0.2230	0.1862	0.1597	0.1428	0.1661	0.2138	0.2492	0.2763	0.2944
0.3662	0.0552	0.3085	0.2478	0.2069	0.1776	0.1589	0.0642	0.0371	0.0230	0.0150	0.0108
0.3722	0.4560	0.3357	0.2699	0.2255	0.1936	0.1733	0.0145	0.0347	0.0531	0.0689	0.0799
0.3781	0.8439	0.3623	0.2915	0.2437	0.2092	0.1874	0.2320	0.3052	0.3603	0.4028	0.4310
0.3970	0.7039	0.4461	0.3600	0.3015	0.2591	0.2328	0.0665	0.1183	0.1620	0.1978	0.2220
0.4048	0.5508	0.4800	0.3880	0.3251	0.2796	0.2515	0.0050	0.0265	0.0509	0.0736	0.0896
0.4206	0.3957	0.5473	0.4439	0.3726	0.3208	0.2894	0.0230	0.0023	0.0005	0.0056	0.0113
0.4335	0.9937	0.6007	0.4887	0.4109	0.3541	0.3204	0.1545	0.2551	0.3397	0.4091	0.4534
0.4365	0.8225	0.6129	0.4990	0.4198	0.3618	0.3276	0.0440	0.1047	0.1622	0.2122	0.2449
0.4402	1.2682	0.6278	0.5116	0.4306	0.3713	0.3365	0.4101	0.5724	0.7015	0.8044	0.8681
0.4410	0.3960	0.6310	0.5143	0.4330	0.3734	0.3384	0.0552	0.0140	0.0014	0.0005	0.0033
0.4443	1.1901	0.6442	0.5256	0.4426	0.3818	0.3463	0.2980	0.4416	0.5587	0.6533	0.7120
0.4468	0.3831	0.6541	0.5340	0.4499	0.3882	0.3523	0.0734	0.0228	0.0045	0.0000	0.0009
0.4537	1.2548	0.6811	0.5572	0.4699	0.4057	0.3689	0.3291	0.4867	0.6160	0.7210	0.7849
0.4574	0.9521	0.6954	0.5695	0.4806	0.4151	0.3778	0.0659	0.1464	0.2223	0.2883	0.3298
0.4825	1.0810	0.7883	0.6509	0.5518	0.4778	0.4380	0.0857	0.1850	0.2801	0.3639	0.4135
0.5128	0.8550	0.8901	0.7438	0.6345	0.5515	0.5107	0.0012	0.0124	0.0486	0.0921	0.1185
0.5153	0.9351	0.8979	0.7512	0.6411	0.5575	0.5167	0.0014	0.0338	0.0864	0.1426	0.1750
0.5219	0.8990	0.9183	0.7704	0.6586	0.5731	0.5326	0.0004	0.0165	0.0578	0.1062	0.1343
0.5426	0.3024	0.9780	0.8286	0.7119	0.6215	0.5822	0.4564	0.2768	0.1677	0.1018	0.0783
0.5433	0.8297	0.9799	0.8305	0.7137	0.6231	0.5839	0.0225	0.0000	0.0135	0.0427	0.0604
0.5553	1.4468	1.0114	0.8625	0.7437	0.6505	0.6127	0.1895	0.3413	0.4944	0.6341	0.6957
0.5693	0.7199	1.0454	0.8984	0.7777	0.6818	0.6463	0.1059	0.0318	0.0033	0.0015	0.0054
0.6224	1.1206	1.1447	1.0180	0.8968	0.7944	0.7738	0.0006	0.0105	0.0501	0.1064	0.1203
0.6524	1.0930	1.1791	1.0733	0.9566	0.8531	0.8458	0.0074	0.0004	0.0186	0.0576	0.0611
0.6681	0.8077	1.1906	1.0984	0.9856	0.8823	0.8834	0.1466	0.0846	0.0316	0.0056	0.0057
0.6787	0.6844	1.1958	1.1139	1.0042	0.9014	0.9089	0.2615	0.1845	0.1023	0.0471	0.0504
0.7000	1.1373	1.2000	1.1413	1.0392	0.9382	0.9600	0.0039	0.0000	0.0096	0.0396	0.0314
0.7291	0.6858	1.2000	1.1704	1.0819	0.9850	1.0298	0.2644	0.2348	0.1569	0.0895	0.1184
0.7382	0.9379	1.2000	1.1775	1.0939	0.9988	1.0517	0.0687	0.0574	0.0243	0.0037	0.0129
0.7401	1.0378	1.2000	1.1788	1.0964	1.0016	1.0562	0.0263	0.0199	0.0034	0.0013	0.0003
0.7534	1.1401	1.2000	1.1872	1.1127	1.0209	1.0882	0.0036	0.0022	0.0008	0.0142	0.0027
0.7806	1.4793	1.2000	1.1978	1.1418	1.0575	1.1534	0.0780	0.0792	0.1138	0.1779	0.1062
0.7853	0.8744	1.2000	1.1987	1.1463	1.0634	1.1647	0.1060	0.1052	0.0739	0.0357	0.0843
0.8007	1.4782	1.2000	1.2000	1.1597	1.0820	1.2000	0.0774	0.0774	0.1014	0.1570	0.0774
0.8043	0.7965	1.2000	1.2000	1.1625	1.0861	1.2000	0.1628	0.1628	0.1340	0.0839	0.1628
0.8180	1.3086	1.2000	1.2000	1.1725	1.1013	1.2000	0.0118	0.0118	0.0185	0.0430	0.0118
0.8190	1.0401	1.2000	1.2000	1.1731	1.1024	1.2000	0.0256	0.0256	0.0177	0.0039	0.0256
0.8337	1.0359	1.2000	1.2000	1.1820	1.1174	1.2000	0.0269	0.0269	0.0213	0.0066	0.0269
0.8367	0.5398	1.2000	1.2000	1.1836	1.1203	1.2000	0.4358	0.4358	0.4144	0.3370	0.4358
0.8513	1.0078	1.2000	1.2000	1.1903	1.1338	1.2000	0.0369	0.0369	0.0333	0.0159	0.0369
0.8536	0.7907	1.2000	1.2000	1.1912	1.1358	1.2000	0.1675	0.1675	0.1604	0.1191	0.1675
0.8733	0.9012	1.2000	1.2000	1.1971	1.1518	1.2000	0.0893	0.0893	0.0875	0.0628	0.0893
0.8817	0.6962	1.2000	1.2000	1.1986	1.1580	1.2000	0.2538	0.2538	0.2524	0.2132	0.2538
0.8867	1.0081	1.2000	1.2000	1.1993	1.1614	1.2000	0.0368	0.0368	0.0365	0.0235	0.0368
0.8914	1.1244	1.2000	1.2000	1.1997	1.1645	1.2000	0.0057	0.0057	0.0057	0.0016	0.0057
0.9228	0.7973	1.2000	1.2000	1.2000	1.1820	1.2000	0.1622	0.1622	0.1622	0.1480	0.1622

0.9718	0.9437	1.2000	1.2000	1.2000	1.1976	1.2000	0.0657	0.0657	0.0657	0.0645	0.0657
1.0351	1.0617	1.2000	1.2000	1.2000	1.2000	1.2000	0.0191	0.0191	0.0191	0.0191	0.0191
1.0649	0.9047	1.2000	1.2000	1.2000	1.2000	1.2000	0.0872	0.0872	0.0872	0.0872	0.0872
1.0811	0.9515	1.2000	1.2000	1.2000	1.2000	1.2000	0.0617	0.0617	0.0617	0.0617	0.0617
1.0813	0.5927	1.2000	1.2000	1.2000	1.2000	1.2000	0.3688	0.3688	0.3688	0.3688	0.3688
1.1069	0.7608	1.2000	1.2000	1.2000	1.2000	1.2000	0.1929	0.1929	0.1929	0.1929	0.1929
1.1084	1.5150	1.2000	1.2000	1.2000	1.2000	1.2000	0.0992	0.0992	0.0992	0.0992	0.0992
1.1391	1.4541	1.2000	1.2000	1.2000	1.2000	1.2000	0.0646	0.0646	0.0646	0.0646	0.0646
1.1642	1.0312	1.2000	1.2000	1.2000	1.2000	1.2000	0.0285	0.0285	0.0285	0.0285	0.0285
1.1709	1.0846	1.2000	1.2000	1.2000	1.2000	1.2000	0.0133	0.0133	0.0133	0.0133	0.0133
1.1725	1.3107	1.2000	1.2000	1.2000	1.2000	1.2000	0.0123	0.0123	0.0123	0.0123	0.0123
1.1734	1.3981	1.2000	1.2000	1.2000	1.2000	1.2000	0.0393	0.0393	0.0393	0.0393	0.0393
1.1782	0.9750	1.2000	1.2000	1.2000	1.2000	1.2000	0.0506	0.0506	0.0506	0.0506	0.0506
1.1908	1.2357	1.2000	1.2000	1.2000	1.2000	1.2000	0.0013	0.0013	0.0013	0.0013	0.0013
1.2150	1.5391	1.2000	1.2000	1.2000	1.2000	1.2000	0.1150	0.1150	0.1150	0.1150	0.1150
1.2625	1.2331	1.2000	1.2000	1.2000	1.2000	1.2000	0.0011	0.0011	0.0011	0.0011	0.0011
1.3545	0.5795	1.2000	1.2000	1.2000	1.2000	1.2000	0.3851	0.3851	0.3851	0.3851	0.3851
1.3818	1.4851	1.2000	1.2000	1.2000	1.2000	1.2000	0.0813	0.0813	0.0813	0.0813	0.0813
1.4101	1.0106	1.2000	1.2000	1.2000	1.2000	1.2000	0.0359	0.0359	0.0359	0.0359	0.0359
1.4250	1.2716	1.2000	1.2000	1.2000	1.2000	1.2000	0.0051	0.0051	0.0051	0.0051	0.0051
1.4429	0.7854	1.2000	1.2000	1.2000	1.2000	1.2000	0.1719	0.1719	0.1719	0.1719	0.1719
1.4942	1.5991	1.2000	1.2000	1.2000	1.2000	1.2000	0.1593	0.1593	0.1593	0.1593	0.1593
			Sum of the Differences Squared				7.7818	8.4362	9.1933	9.9261	10.8327

Variation of the Data to the best fit lines
- Minor Flow in Opposed Flow
1 Person Opposing

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2095	0.6578	0.0000	0.0000	0.0000	0.0000	0.0000	0.4327	0.4327	0.4327	0.4327	0.4327
0.2436	0.1282	0.0000	0.0000	0.0000	0.0000	0.0000	0.0164	0.0164	0.0164	0.0164	0.0164
0.2594	0.4375	0.0000	0.0000	0.0000	0.0000	0.0000	0.1914	0.1914	0.1914	0.1914	0.1914
0.2647	0.2894	0.0000	0.0000	0.0000	0.0000	0.0000	0.0838	0.0838	0.0838	0.0838	0.0838
0.2760	0.2018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0407	0.0407	0.0407	0.0407	0.0407
0.3052	0.5631	0.0245	0.0196	0.0163	0.0140	0.0125	0.2901	0.2954	0.2989	0.3015	0.3032
0.3123	0.3629	0.0579	0.0464	0.0386	0.0331	0.0295	0.0930	0.1002	0.1051	0.1087	0.1111
0.3129	0.8929	0.0608	0.0486	0.0405	0.0347	0.0310	0.6924	0.7127	0.7265	0.7364	0.7429
0.3242	0.5768	0.1139	0.0911	0.0760	0.0651	0.0581	0.2143	0.2359	0.2509	0.2618	0.2691
0.3296	0.3345	0.1392	0.1114	0.0929	0.0796	0.0710	0.0382	0.0498	0.0584	0.0649	0.0694
0.3351	0.3155	0.1649	0.1321	0.1101	0.0944	0.0842	0.0227	0.0337	0.0422	0.0489	0.0535
0.3409	0.4570	0.1919	0.1538	0.1282	0.1100	0.0982	0.0703	0.0920	0.1081	0.1204	0.1288
0.3657	0.5689	0.3062	0.2459	0.2054	0.1763	0.1577	0.0690	0.1043	0.1322	0.1542	0.1691
0.3701	0.2320	0.3262	0.2621	0.2190	0.1880	0.1682	0.0089	0.0009	0.0002	0.0019	0.0041
0.3717	0.8663	0.3334	0.2680	0.2239	0.1922	0.1721	0.2839	0.3579	0.4126	0.4543	0.4819
0.3717	0.4409	0.3334	0.2680	0.2239	0.1922	0.1721	0.0116	0.0299	0.0471	0.0619	0.0723
0.3883	0.6623	0.4078	0.3286	0.2749	0.2362	0.2119	0.0648	0.1114	0.1501	0.1816	0.2029
0.3916	0.9041	0.4224	0.3406	0.2850	0.2449	0.2198	0.2320	0.3175	0.3832	0.4345	0.4682
0.4310	0.4602	0.5905	0.4800	0.4035	0.3477	0.3144	0.0170	0.0004	0.0032	0.0127	0.0213
0.4351	1.0929	0.6072	0.4942	0.4156	0.3582	0.3242	0.2359	0.3585	0.4587	0.5397	0.5908
0.4419	1.0450	0.6346	0.5174	0.4356	0.3757	0.3406	0.1684	0.2784	0.3714	0.4480	0.4962
0.4435	0.7804	0.6410	0.5228	0.4403	0.3798	0.3444	0.0194	0.0663	0.1157	0.1605	0.1901
0.4552	0.4710	0.6869	0.5622	0.4743	0.4095	0.3725	0.0466	0.0083	0.0000	0.0038	0.0097
0.4797	0.6216	0.7783	0.6420	0.5439	0.4709	0.4313	0.0245	0.0004	0.0060	0.0227	0.0362
0.5283	1.0284	0.9374	0.7888	0.6753	0.5882	0.5479	0.0083	0.0574	0.1247	0.1938	0.2309
0.5374	0.7981	0.9636	0.8143	0.6987	0.6095	0.5698	0.0274	0.0003	0.0099	0.0356	0.0522
0.5712	1.4502	1.0497	0.9031	0.7822	0.6860	0.6509	0.1604	0.2993	0.4463	0.5840	0.6390
0.5893	1.3204	1.0884	0.9466	0.8244	0.7254	0.6943	0.0538	0.1398	0.2460	0.3540	0.3920
0.5941	0.8688	1.0977	0.9576	0.8353	0.7357	0.7058	0.0524	0.0079	0.0011	0.0177	0.0265
0.6224	1.1127	1.1447	1.0180	0.8968	0.7944	0.7738	0.0010	0.0090	0.0466	0.1013	0.1149
0.6295	1.4535	1.1543	1.0319	0.9115	0.8086	0.7908	0.0895	0.1777	0.2938	0.4159	0.4392
0.6581	0.9933	1.1838	1.0827	0.9673	0.8638	0.8594	0.0363	0.0080	0.0007	0.0168	0.0179
0.6738	0.8440	1.1937	1.1069	0.9957	0.8926	0.8971	0.1223	0.0691	0.0230	0.0024	0.0028
0.7150	0.4862	1.2000	1.1575	1.0620	0.9628	0.9960	0.5096	0.4506	0.3316	0.2272	0.2599
0.7203	1.4669	1.2000	1.1626	1.0696	0.9713	1.0087	0.0712	0.0926	0.1578	0.2456	0.2099
0.7323	0.4012	1.2000	1.1730	1.0862	0.9899	1.0375	0.6381	0.5956	0.4692	0.3466	0.4049
0.7558	0.8531	1.2000	1.1884	1.1155	1.0243	1.0939	0.1203	0.1124	0.0688	0.0293	0.0580
0.7883	0.8588	1.2000	1.1992	1.1491	1.0671	1.1719	0.1164	0.1159	0.0843	0.0434	0.0981
0.9004	1.0653	1.2000	1.2000	1.2000	1.1702	1.2000	0.0182	0.0182	0.0182	0.0110	0.0182
0.9262	1.5462	1.2000	1.2000	1.2000	1.1836	1.2000	0.1199	0.1199	0.1199	0.1315	0.1199
0.9379	1.1224	1.2000	1.2000	1.2000	1.1884	1.2000	0.0060	0.0060	0.0060	0.0043	0.0060
0.9878	1.1354	1.2000	1.2000	1.2000	1.1996	1.2000	0.0042	0.0042	0.0042	0.0041	0.0042
1.0256	1.3046	1.2000	1.2000	1.2000	1.2000	1.2000	0.0109	0.0109	0.0109	0.0109	0.0109
1.3848	1.3406	1.2000	1.2000	1.2000	1.2000	1.2000	0.0198	0.0198	0.0198	0.0198	0.0198
1.4825	1.2732	1.2000	1.2000	1.2000	1.2000	1.2000	0.0054	0.0054	0.0054	0.0054	0.0054
1.5782	1.4672	1.2000	1.2000	1.2000	1.2000	1.2000	0.0714	0.0714	0.0714	0.0714	0.0714
2.0095	1.0289	1.2000	1.2000	1.2000	1.2000	1.2000	0.0293	0.0293	0.0293	0.0293	0.0293
2.0183	1.2302	1.2000	1.2000	1.2000	1.2000	1.2000	0.0009	0.0009	0.0009	0.0009	0.0009
		Sum of the Differences Squared					5.6609	6.3404	7.0250	7.7856	8.4177

Variation of the Data to the best fit lines
- Minor Flow in Opposed Flow
3 People Opposing

		Movement Velocity					Velocity Differences Squared				
Interperson Distance, m	Movement Velocity m/s	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E	Best fit Line A	Best fit Line B	Best fit Line C	Best fit Line D	Best fit Line E
0.2725	0.9748	0.0000	0.0000	0.0000	0.0000	0.0000	0.9503	0.9503	0.9503	0.9503	0.9503
0.2752	0.3952	0.0000	0.0000	0.0000	0.0000	0.0000	0.1562	0.1562	0.1562	0.1562	0.1562
0.2799	0.0468	0.0000	0.0000	0.0000	0.0000	0.0000	0.0022	0.0022	0.0022	0.0022	0.0022
0.2881	0.3393	0.0000	0.0000	0.0000	0.0000	0.0000	0.1152	0.1152	0.1152	0.1152	0.1152
0.2993	0.5425	0.0000	0.0000	0.0000	0.0000	0.0000	0.2943	0.2943	0.2943	0.2943	0.2943
0.3051	0.2242	0.0240	0.0192	0.0160	0.0137	0.0122	0.0401	0.0420	0.0434	0.0443	0.0449
0.3159	0.8318	0.0749	0.0599	0.0499	0.0428	0.0382	0.5730	0.5958	0.6113	0.6226	0.6299
0.3220	0.9170	0.1035	0.0829	0.0691	0.0592	0.0528	0.6617	0.6958	0.7190	0.7358	0.7468
0.3271	0.4158	0.1275	0.1020	0.0851	0.0729	0.0650	0.0831	0.0984	0.1094	0.1175	0.1230
0.3294	0.3221	0.1382	0.1107	0.0923	0.0791	0.0706	0.0338	0.0447	0.0528	0.0590	0.0633
0.3409	0.4350	0.1919	0.1538	0.1282	0.1100	0.0982	0.0591	0.0791	0.0941	0.1056	0.1135
0.3420	0.1771	0.1970	0.1579	0.1317	0.1129	0.1008	0.0004	0.0004	0.0021	0.0041	0.0058
0.3434	0.1952	0.2035	0.1631	0.1361	0.1167	0.1042	0.0001	0.0010	0.0035	0.0062	0.0083
0.3449	0.7183	0.2105	0.1687	0.1407	0.1207	0.1078	0.2579	0.3020	0.3336	0.3571	0.3727
0.3761	0.4115	0.3533	0.2842	0.2375	0.2039	0.1826	0.0034	0.0162	0.0303	0.0431	0.0524
0.3787	1.1399	0.3650	0.2937	0.2455	0.2108	0.1889	0.6004	0.7160	0.7999	0.8631	0.9044
0.4166	0.4153	0.5305	0.4298	0.3606	0.3104	0.2798	0.0133	0.0002	0.0030	0.0110	0.0183
0.4272	1.1999	0.5748	0.4669	0.3923	0.3379	0.3053	0.3908	0.5374	0.6523	0.7431	0.8004
0.4327	0.1548	0.5974	0.4859	0.4086	0.3521	0.3185	0.1959	0.1096	0.0644	0.0389	0.0268
0.4656	0.9241	0.7265	0.5965	0.5041	0.4357	0.3974	0.0390	0.1073	0.1764	0.2385	0.2773
0.4700	0.4421	0.7429	0.6108	0.5166	0.4468	0.4080	0.0905	0.0285	0.0055	0.0000	0.0012
0.4809	0.5425	0.7826	0.6459	0.5473	0.4739	0.4342	0.0576	0.0107	0.0000	0.0047	0.0117
0.4815	0.4357	0.7847	0.6478	0.5490	0.4753	0.4356	0.1218	0.0450	0.0128	0.0016	0.0000
0.5304	0.8617	0.9435	0.7947	0.6807	0.5931	0.5530	0.0067	0.0045	0.0328	0.0721	0.0953
0.5374	0.7528	0.9636	0.8143	0.6987	0.6095	0.5698	0.0444	0.0038	0.0029	0.0205	0.0335
0.5472	0.7194	0.9904	0.8410	0.7235	0.6320	0.5933	0.0734	0.0148	0.0000	0.0076	0.0159
0.5511	0.9353	1.0006	0.8515	0.7333	0.6409	0.6026	0.0043	0.0070	0.0408	0.0866	0.1107
0.5514	0.9795	1.0014	0.8523	0.7340	0.6416	0.6034	0.0005	0.0162	0.0603	0.1141	0.1415
0.5650	1.3411	1.0353	0.8876	0.7673	0.6723	0.6360	0.0935	0.2057	0.3292	0.4473	0.4971
0.5989	1.3405	1.1067	0.9684	0.8461	0.7459	0.7174	0.0547	0.1385	0.2445	0.3536	0.3883
0.6129	0.5760	1.1305	0.9986	0.8767	0.7750	0.7510	0.3074	0.1786	0.0904	0.0396	0.0306
0.6551	1.1247	1.1814	1.0778	0.9617	0.8582	0.8522	0.0032	0.0022	0.0266	0.0710	0.0742
0.6564	1.0639	1.1825	1.0799	0.9641	0.8606	0.8554	0.0141	0.0003	0.0100	0.0413	0.0435
0.6641	1.1556	1.1881	1.0923	0.9783	0.8749	0.8738	0.0011	0.0040	0.0314	0.0787	0.0794
0.6782	0.2811	1.1956	1.1132	1.0033	0.9005	0.9077	0.8363	0.6924	0.5216	0.3836	0.3926
0.6910	0.9428	1.1993	1.1303	1.0248	0.9229	0.9384	0.0658	0.0352	0.0067	0.0004	0.0000
0.7968	0.5559	1.2000	1.1999	1.1565	1.0774	1.1923	0.4148	0.4147	0.3606	0.2719	0.4050
0.8351	1.1076	1.2000	1.2000	1.1827	1.1188	1.2000	0.0085	0.0085	0.0056	0.0001	0.0085
0.8504	1.0871	1.2000	1.2000	1.1899	1.1330	1.2000	0.0127	0.0127	0.0106	0.0021	0.0127
0.8633	0.4610	1.2000	1.2000	1.1945	1.1440	1.2000	0.5461	0.5461	0.5379	0.4664	0.5461
0.8924	1.3541	1.2000	1.2000	1.1998	1.1652	1.2000	0.0237	0.0237	0.0238	0.0357	0.0237
0.9615	0.7868	1.2000	1.2000	1.2000	1.1955	1.2000	0.1707	0.1707	0.1707	0.1671	0.1707
1.0692	1.4928	1.2000	1.2000	1.2000	1.2000	1.2000	0.0857	0.0857	0.0857	0.0857	0.0857
1.1607	1.4985	1.2000	1.2000	1.2000	1.2000	1.2000	0.0891	0.0891	0.0891	0.0891	0.0891
1.3187	1.1844	1.2000	1.2000	1.2000	1.2000	1.2000	0.0002	0.0002	0.0002	0.0002	0.0002
1.4746	1.3118	1.2000	1.2000	1.2000	1.2000	1.2000	0.0125	0.0125	0.0125	0.0125	0.0125
1.7176	0.8785	1.2000	1.2000	1.2000	1.2000	1.2000	0.1033	0.1033	0.1033	0.1033	0.1033
1.7705	1.2704	1.2000	1.2000	1.2000	1.2000	1.2000	0.0050	0.0050	0.0050	0.0050	0.0050
1.8328	0.7714	1.2000	1.2000	1.2000	1.2000	1.2000	0.1837	0.1837	0.1837	0.1837	0.1837

1.8413	1.1907	1.2000	1.2000	1.2000	1.2000	1.2000	0.0001	0.0001	0.0001	0.0001	0.0001
1.8484	0.9663	1.2000	1.2000	1.2000	1.2000	1.2000	0.0546	0.0546	0.0546	0.0546	0.0546
1.8815	1.1840	1.2000	1.2000	1.2000	1.2000	1.2000	0.0003	0.0003	0.0003	0.0003	0.0003
1.8839	1.5532	1.2000	1.2000	1.2000	1.2000	1.2000	0.1247	0.1247	0.1247	0.1247	0.1247
1.9054	0.9241	1.2000	1.2000	1.2000	1.2000	1.2000	0.0761	0.0761	0.0761	0.0761	0.0761
1.9119	1.6643	1.2000	1.2000	1.2000	1.2000	1.2000	0.2156	0.2156	0.2156	0.2156	0.2156
1.9265	1.3383	1.2000	1.2000	1.2000	1.2000	1.2000	0.0191	0.0191	0.0191	0.0191	0.0191
			Sum of the Differences Squared				8.3919	8.3979	8.7083	9.1445	9.7584